75th Year of service to the advancing power field

Power

NOVEMBER 1957
ONE DOLLAR
A McGRAW-HILL PUBLICATION

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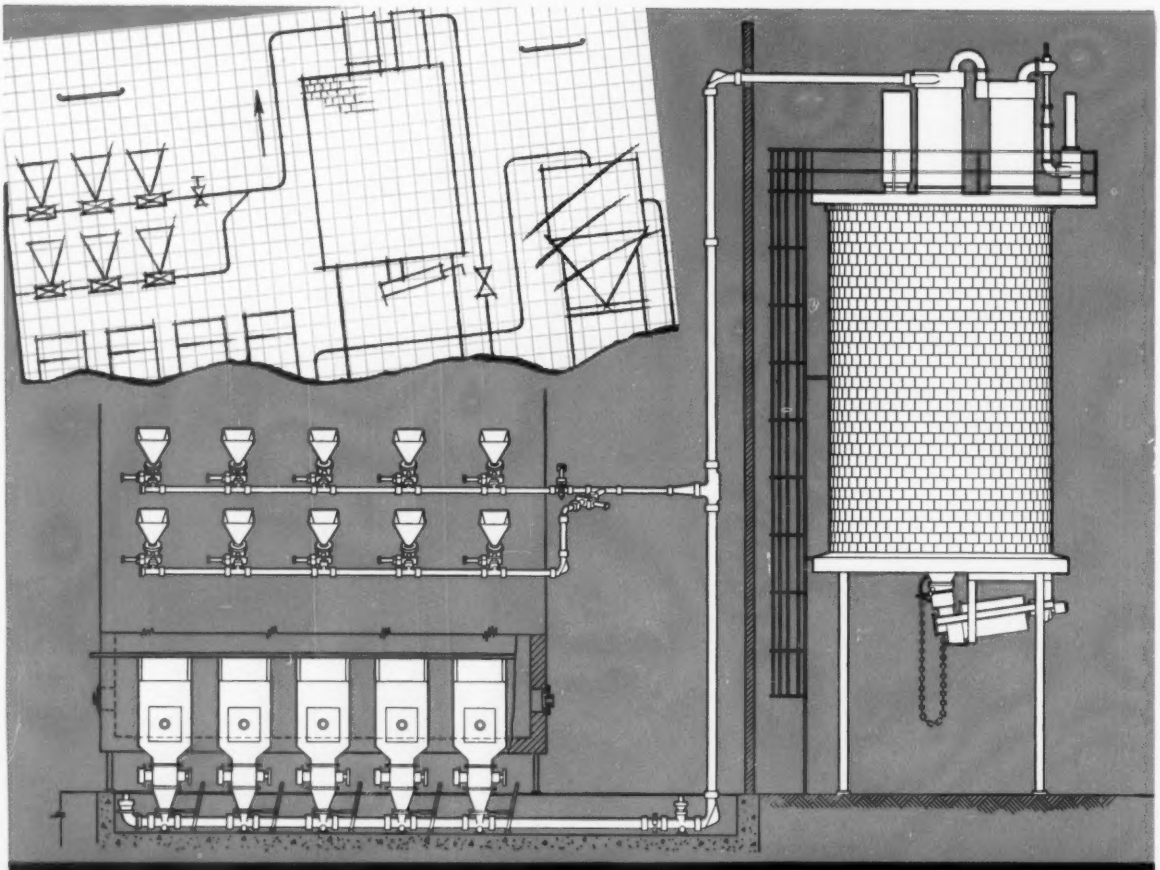


Let A-S-H help with your ash handling problem

FROM FIRST-STAGE DISCUSSION TO FINAL SOLUTION *

What type ash handling system's *just right* for your plant?

A dry system using a steam jet exhauster or blower, discharging to silo or fill area? A wet system with centrifugal type or jet type pump, discharging to bin, fill area, or sump? A combination system—pneumatic for flyash, hydraulic for bottom ash? Or some other?

A-S-H has *project engineered* ash handling systems of every type for power plants throughout the world. In helping plan these installations, in making available many years of specialized experience, A-S-H engineers have helped save the power and engineering companies concerned considerable time and money.

A-S-H can and will help you solve knotty handling problems during every stage of development from initial planning through prompt servicing. Where feasible, A-S-H standard equipment is specified. Where conditions dictate, A-S-H never hesitates to redesign, modify—*even invent*—components to provide the best possible problem solution.

Solving ash handling problems is a big part of our business. There are none too small, none too big for us to tackle. We're interested in *your* job, be it a simple system for a small boiler plant (like the one shown above) or a new concept never before tried.

Acquaint us with your requirements. Ask us for helpful data or for our field engineer to call. You'll get *prompt* attention.

* *A-S-H service doesn't stop with installation. When service problems come up, we stand ready to give prompt service assistance. This is a policy worth considering when suppliers are being selected.*

MATERIALS HANDLING SYSTEMS

"Hydrojet" *hydraulic*

"Hydrovac" *pneumatic*

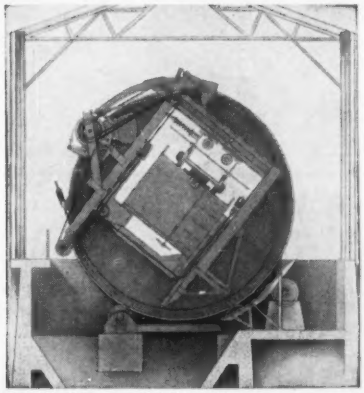
A-S-H

the **Allen-Sherman-Hoff** company

259 E. Lancaster Ave., Wynnewood, Pa.

Offices and representatives in principal cities

BOTTOMS UP



DUMPING CYCLE IS SIMPLE. With car in position, rotation is controlled by means of lever. As car begins to tilt, the transfer table moves sidewise until side of car rests against it. Simultaneously, overhead self-adjusting clamps descend on top of car and hold if securely to rails. Rotation continues until car is overturned. Dumper is automatically stopped by limit switch. Pushing lever in opposite direction returns the dumper to normal position.

LINK-BELT rotary car dumpers empty 90-ton gondola cars in 60 seconds

One minute and one man—that's all it takes to unload a carload of coal with a Link-Belt rotary car dumper. The entire operation is lever controlled—permits unloading of 15 or more cars per hour including normal spotting and handling time. This foolproof system handles gondola cars of all sizes, with capacities up to 90 tons . . . cuts costly demurrage charges . . . minimizes operational hazards and accidents. For facts, call your Link-Belt office. Write for Book 2048-A.

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ROTARY CAR DUMPERS

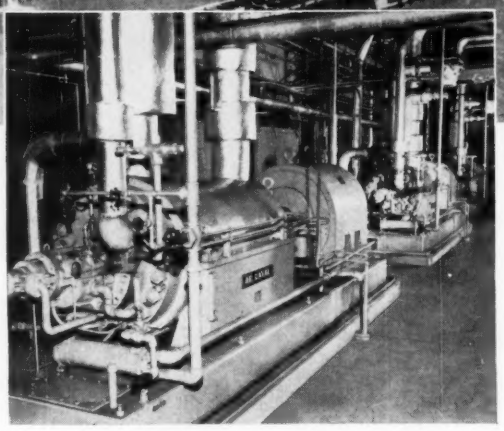
14.570

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

Modern central stations use

DE LAVAL

BARREL TYPE BOILER FEED PUMPS

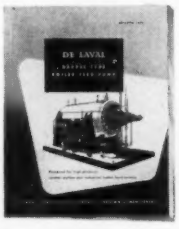


Three ten-stage De Laval high pressure, barrel type boiler feed pumps, are on the line at the Deepwater Station of the Atlantic City Electric Company. Shown above is an aerial view of this station located in Penns Grove, New Jersey at the southern end of the Jersey Turnpike. Each pump delivers 675 gpm to the boiler for a total flow of 685,000 pounds per hour. Each pump operates at 1762 psi with temperature at 287 F., and is driven by a 900 hp motor.

When it came time to modernize one of their existing facilities, Atlantic City Electric Company and Gibbs & Hill, Inc., consulting engineers, chose two similar De Laval pumps to serve a new 79,000 kw generator.

IMO Pumps For Fuel Oil Service

Also doing an important job in this Atlantic City Electric Company station are De Laval IMO screw-type positive displacement pumps. They supply fuel oil to the burners round the clock.



Send for De Laval Bulletin 1506, which contains helpful data.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL-386

Power

NOVEMBER 1957 • VOLUME 101 NUMBER 11

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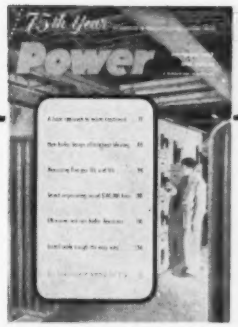

THE 3-FOLD PURPOSE of a magazine cover is to identify the specific magazine, set one issue off from another, and give the reader a taste of what's inside. This month Art Editor Marshalek combines these three aims in a somewhat new approach.

Adhering to POWER'S policy of cover flexibility, future issues will also witness many design variations . . . but each in keeping with this basic 3-part formula.

Next month . . .

Modern plant survey, slated for the December issue, lists the important industrial power plants plus all steam and hydro stations installed to date in the U.S. and Canada. Highlighted will be trends in both industrial and central station operation.

Supercritical boilers call for use of valves at pressures higher than existing ASA standards. To date, each need has been met on almost an individual basis. To correct this situation, upcoming article proposes a new standard class for valves in the pressure range above 2500 psi.

Ultrasonics, answer to a maintenance man's prayer, gets a 3-page treatment in December. Article shows just what this new maintenance aid can do.

. . . and a future month

NEW POWER JOBS for the electronic computer is theme of first of a series of staff reports highlighting new developments in specific power-field areas. Watch for it in January.

Print order this issue: 49,984

November 1957 — POWER — Vol 101—No. 11

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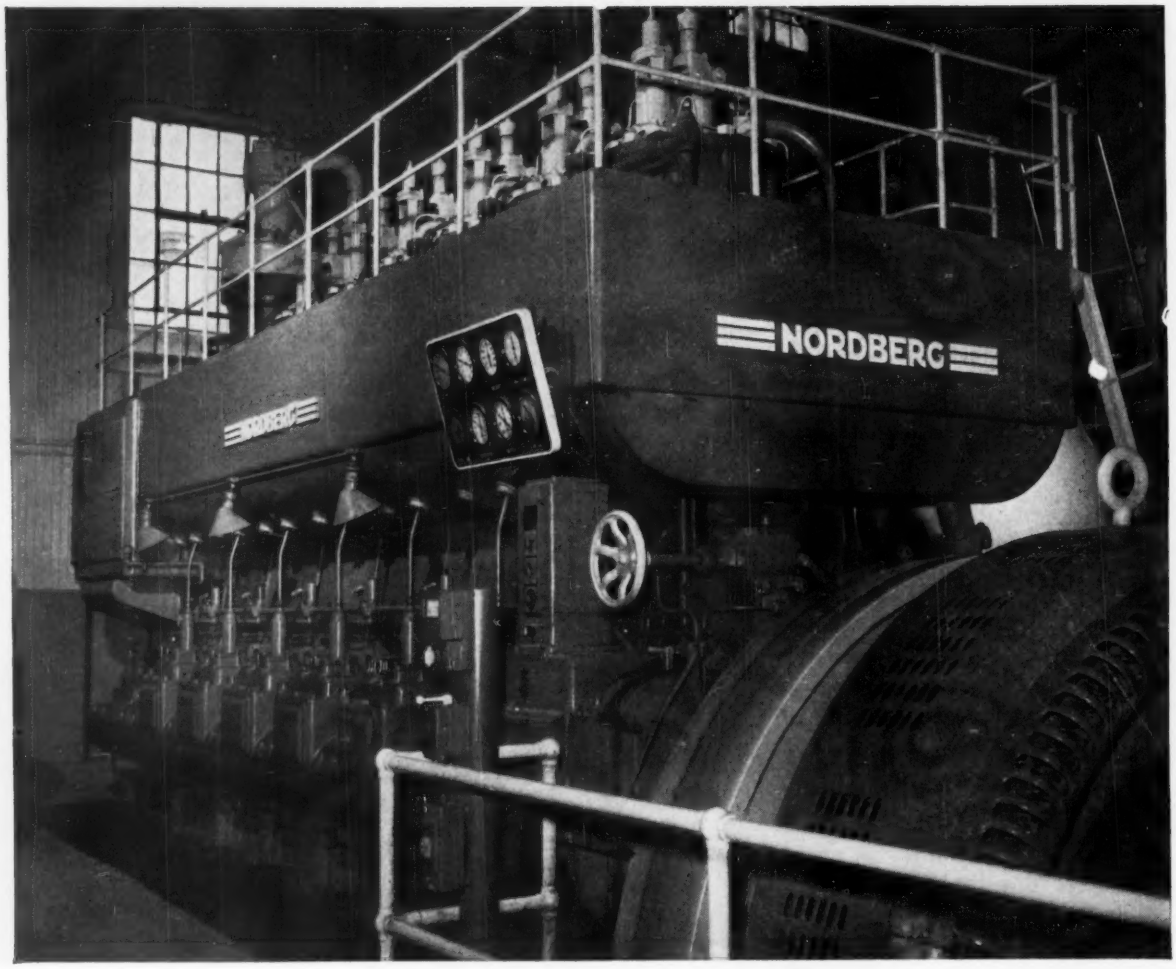

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When fuel and maintenance bills get out of hand and power's not up to par, chances are your oil is the culprit. Let your Texaco Lubrication Engineer recommend the proper grade of *Texaco Ursa Oil*.

Texaco Ursa Oils keep diesel systems running clean for full compression and complete combustion . . . prevent harmful deposits in the combustion chamber, in crankcase and on valves. They help minimize ring, cylinder and bearing wear—all of which adds up to full power on less fuel and lower maintenance costs.

For over twenty years more stationary diesel horsepower in the United States has been lubricated with Texaco than with any other brand.

There is a complete line of *Texaco Ursa Oils* to meet the requirements of all diesel. gas and dual-fuel engines.

Just call the nearest of more than 2,000 Texaco Distributing Plants in the 48 States—or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

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FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

speaking of **Power**

Power's editorial plans: geared to meet industry's growing needs

A sizable portion of POWER's 75th anniversary issue was based on an ever-popular custom: taking a hard look ahead. Our look ahead was mainly concerned with fast-changing power equipment. In some areas POWER editors had to reach for their crystal balls, but they always made sure that the balls were pretty well supported on solid ground. POWER pinned down many trends and predicted others likely to be with us in the future. The net results was a well-rounded picture of power-field growth building up to a truly bigger tomorrow.

But as the power field grows, so grow the responsibilities of POWER editors. Long- and short-range plans are in the making to fill your greater needs. At a recent two-day meeting of McGraw-Hill's management people, editors and publishers traded details of their plans for meeting still-growing needs of our industrial economy. Specifically, they took a critical look at publishing plans for 1958. At this meeting POWER editors concentrated on short-range aims, a pattern which will start evolving with the January issue. Here are a few of the many improvements that you can expect in the next few months:

Monthly staff reports, either the traditional POWER "special report" or technical news reports, will bow in with the January issue. Each issue not containing a special report of the type that has become a sort of POWER trademark will carry a newsy staff-written roundup, running four, six or eight pages and highlighting up-to-the-minute thinking in some area of the power field that's currently undergoing change. Departing somewhat from the theme of our special reports, the shorter technical roundup will concentrate on pointing up newsworthy changes rather than discussing engineering fundamentals.

PTG . . . *electrically* which made its first appearance on POWER's pages in September, 1956 will continue at a stepped-up tempo. Born because of the marked lack of forward planning in the electrical-distribution area within many industrial plants, service establishments and commercial buildings, PTG will give even greater engineering support to the philosophy of better planning . . . better planning electrically.

Nuclear seminars, designed to give management men a brief version of nuclear power happenings, will be continued as long as the demand exists. They will, as before, serve those who must keep abreast of the technological and business aspects of the harnessed atom in order to stay in business. The future will probably see the seminars return in two forms: two-day sessions for newcomers and those who missed our first round of seminars; one-day meetings as refreshers.

Editorial features that appear within the magazine will continue to do so amid somewhat changed surroundings. You will notice with the coming of the new year a pronouncedly easier-to-read type. Many of the present departments are up on the block for possible redesign. All changes within the magazine will be made with an eye toward reader appeal—making POWER better, faster reading for the busy engineer.

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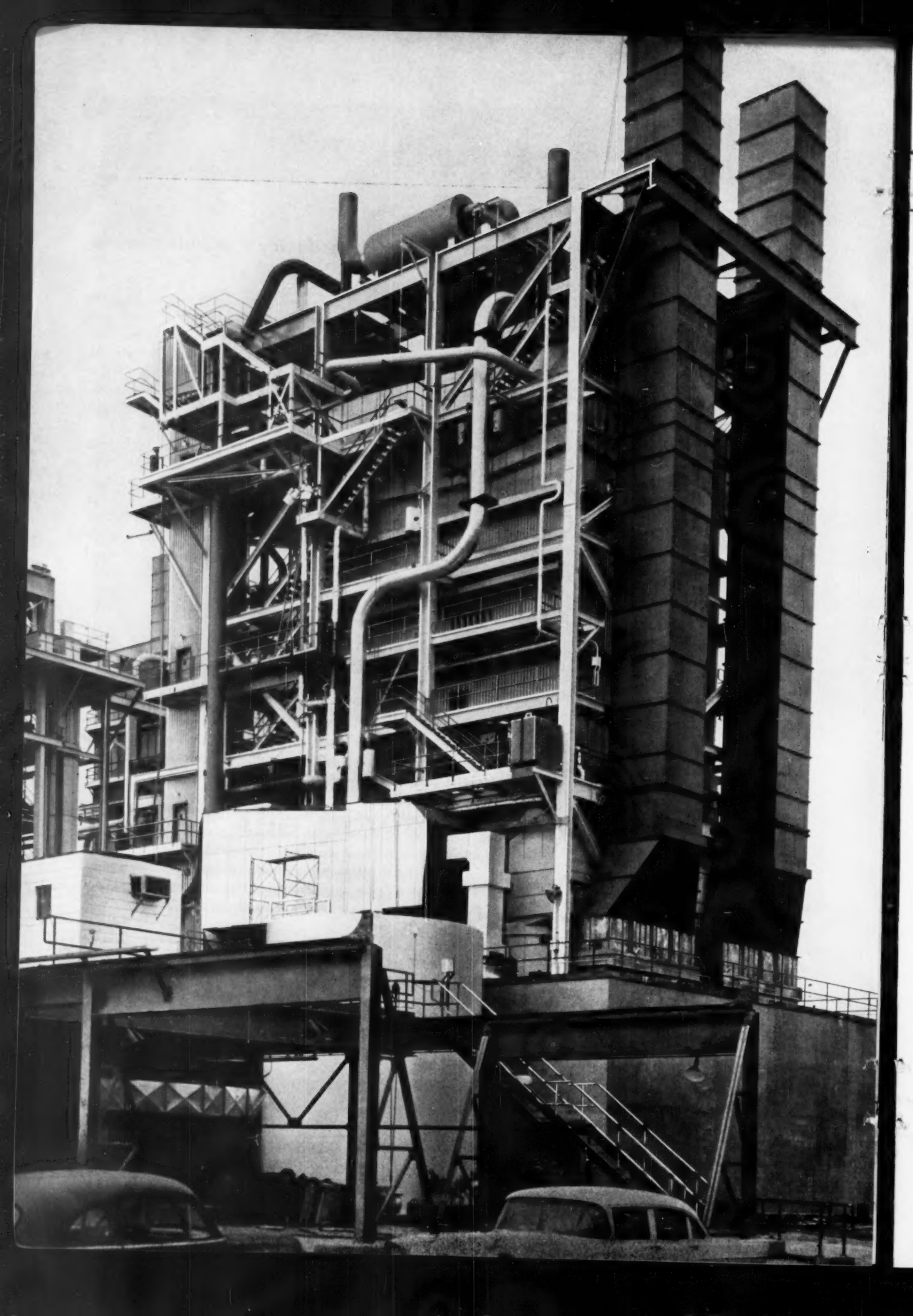
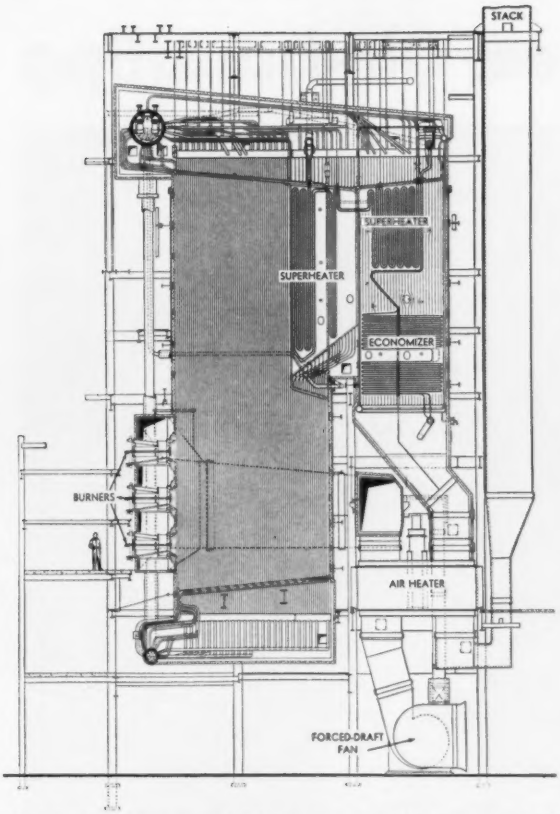
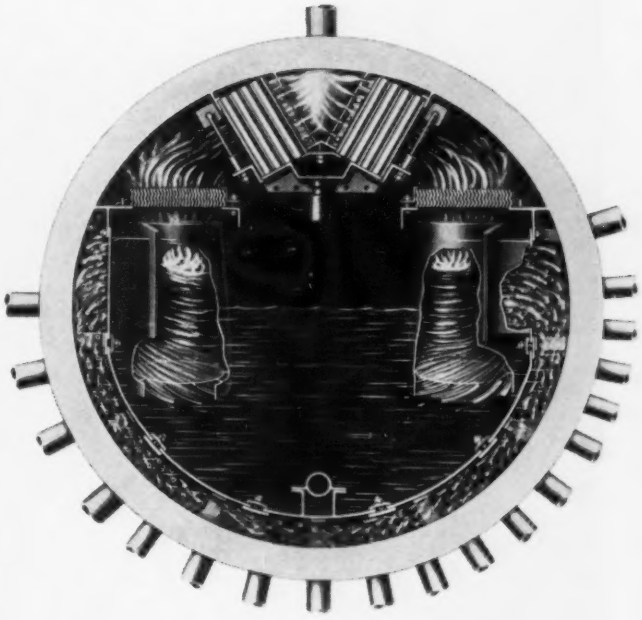




Third B&W Boiler at Parkdale Station of Dallas Power & Light Company has a capacity of 1,050,000 lb of steam per hr at 1550 psi at superheater outlet and 1005 F. Design pressure 1725 psi. Consulting Engineers: Ebasco Services, Inc., New York.



B&W Cyclone Steam Separators help insure clean, dry, high-purity steam output for the turbine, keeping it on the line for longer periods between cleanings.

Another B&W Boiler for Dallas Power & Light Company

Third unit at Parkdale Station with B&W Cyclone Steam Separators provides clean, dry, high purity steam. Provisions in design for future coal firing

A B&W Pressurized-Furnace Boiler, the third at Parkdale Station, has gone on the line for the Dallas Power & Light Company. The latest unit, now fired by gas has design provisions for future addition of a hopper bottom and division wall for coal firing.

B&W Cyclone Steam Separators insure clean, dry, high purity steam output for the turbine. In the original design phase of B&W units, features are included to fit specific needs—and the future needs—of the purchaser. When a unit is designed, provision can be made for alternate systems of firing, depending upon future fuel availabilities. In the new Dallas Power & Light unit, conversion to future coal-firing can be accomplished should conditions in the area so warrant.

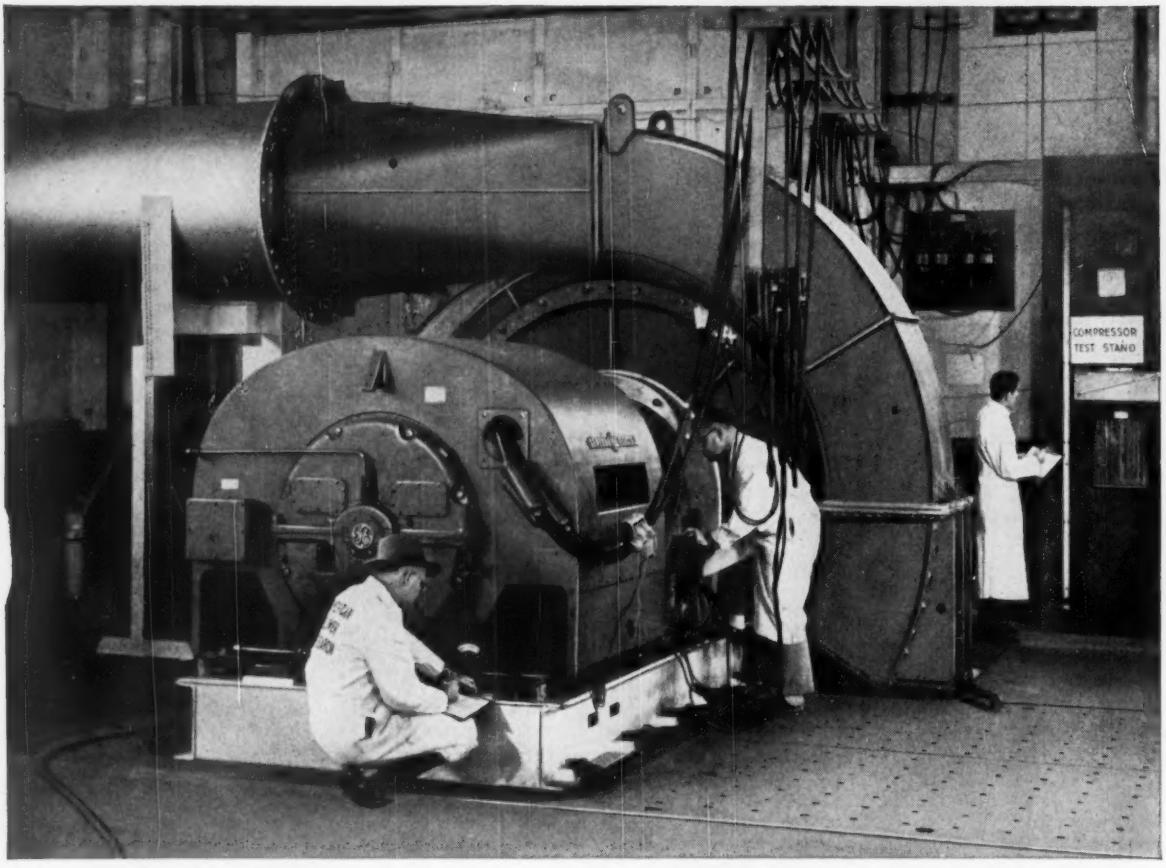
National network of B&W plants and engineering facilities provides important advantages. Service and assistance is always near at hand from a nearby link in this chain. Supported by nearly a century of steam generating experience, B&W design, research and development can help you and your engineers with your central station requirements. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX

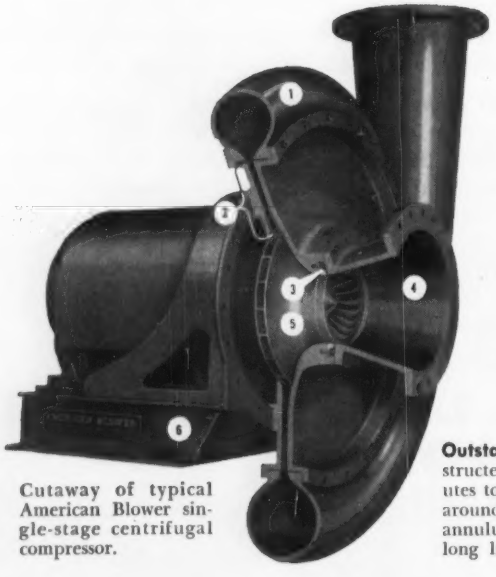
BOILER DIVISION

G-864-C5

Here's the latest air-handling



LABORATORY TESTED CENTRIFUGAL COMPRESSOR DELIVERS 330,805 POUNDS OF AIR PER HOUR!



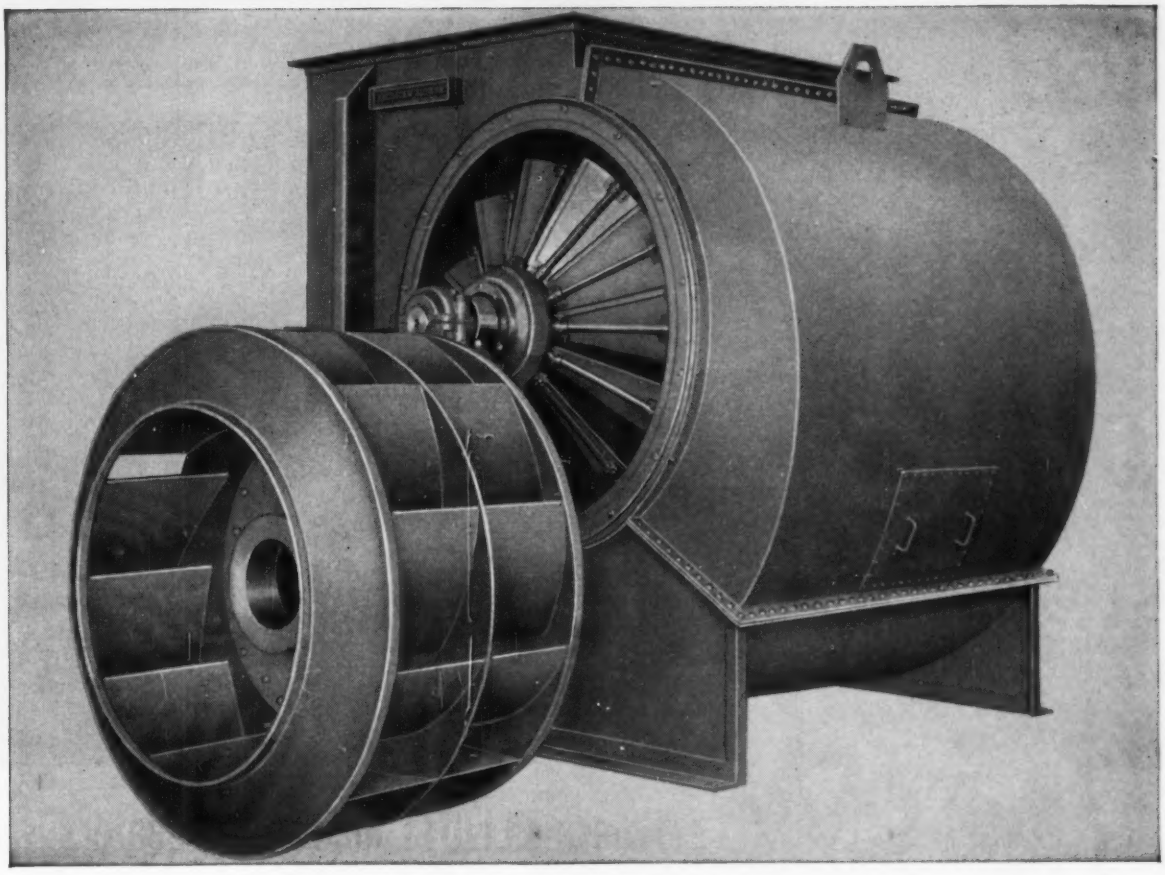
Cutaway of typical American Blower single-stage centrifugal compressor.

With the trend toward higher pressure requirements, American Blower has designed and built centrifugal compressors to furnish air for cyclone fired boilers. These compressors incorporate the use of a horizontally split, welded steel volute casing, variable inlet guide vanes, welded steel impeller of the shrouded type with impeller shaft supported by two journal bearings plus a Kingsbury thrust bearing arranged for positive forced-feed lubrication. This highly efficient compressor is driven by a 1000 HP, 1800 rpm, induction motor, delivers 330,805 pounds of air per hour at a static discharge pressure of 67.5 inches water gauge.

Like every American Blower single-stage centrifugal compressor – 30 to 2250 HP – this compressor has been completely tested in accordance with the A.S.M.E. Power Test Code. Such testing guarantees the mechanical operation and performance of all American Blower compressors.

Outstanding features: (1) Improved scroll-shaped casing design. (2) Unobstructed long diffuser passage converts velocity energy into pressure, contributes to quiet operation. (3) Annulus packing minimizes recirculation of gas around impeller inlet. (4) Removable inlet nozzle for accurate alignment of annulus packing. (5) Aero-dynamic design of impeller blades for high efficiency, long life. (6) Welded-steel baseplate "stress relieved" prior to machining.

equipment from American Blower

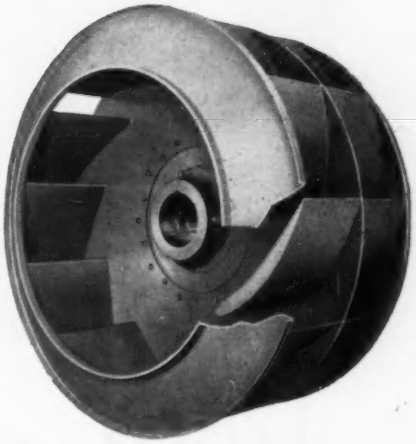


AIRFOIL FAN HAS ADVANCED DESIGN FOR HIGH EFFICIENCY, LOW OPERATING COST

Featuring a functionally designed airfoil blade, American Blower's improved Airfoil Fan is the industry's best in the non-overloading-horsepower type of centrifugal fan.

That's because smooth interworking of improved streamline inlets, wheel rims, and housing minimizes turbulence, resulting in higher efficiency, lower power consumption. The non-overloading-horsepower characteristic makes it possible to select a driving motor close to the fan horsepower.

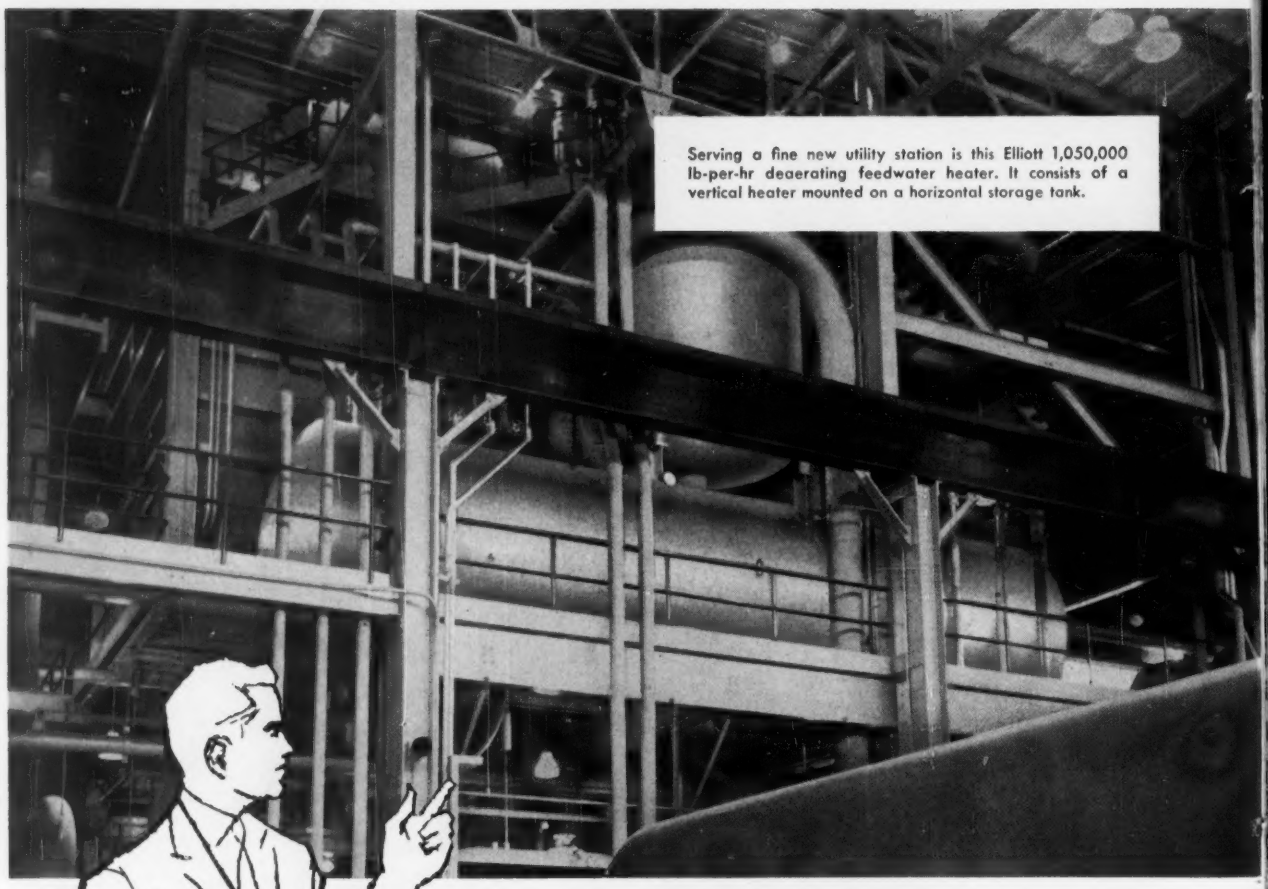
Why not talk to an American Blower sales engineer about *your* requirements. His knowledge of air-handling applications can prove invaluable to you. Call our nearest branch office, or write: American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products.



Special design of the airfoil blade and matching streamline inlet are the top features of American Blower Airfoil Fan. The dieformed, reinforced, and welded blades are extra strong, extremely efficient. Single- and double-inlet Airfoil Fans are available in many sizes, and for volumes up to 1,000,000 cfm.

AMERICAN BLOWER

Division of AMERICAN-Standard



Serving a fine new utility station is this Elliott 1,050,000 lb-per-hr deaerating feedwater heater. It consists of a vertical heater mounted on a horizontal storage tank.

"These ELLIOTT deaerating heaters were designed to meet specific requirements and prevent corrosion to water-handling equipment"

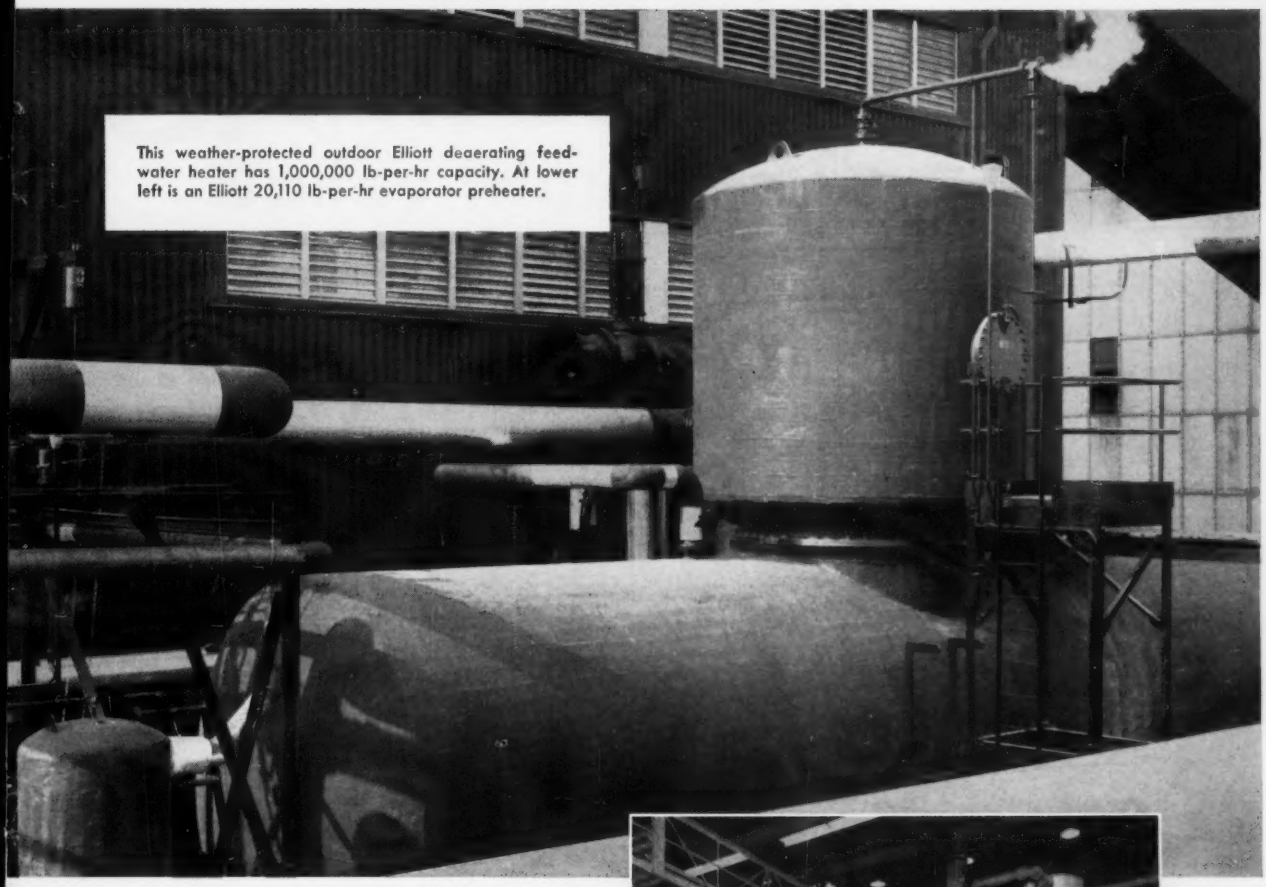
For almost 40 years, Elliott has been designing and building deaerating feedwater heaters in all sizes . . . for small and medium-sized power plants up to giant heaters with a capacity of 2,500,000 lb per hr.

The heaters seen here illustrate Elliott's wide experience and versatility. They are engineered to remove corrosion-causing oxygen from boiler feedwater . . . meet individual thermal requirements . . . to be "tucked away" to fit the most confining space limitations . . . or for rugged outdoor service.

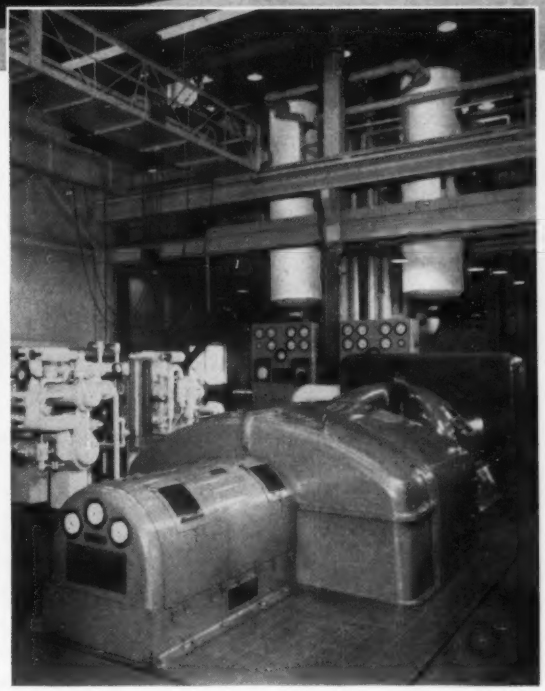
All Elliott deaerating heaters are made of the finest materials and good workmanship to insure the most economical, long-term, continuous performance. They are tops with utilities all over the country. Elliott heaters not only provide feedwater heated to the temperature of saturated steam, they also protect boiler tubes, piping, pumps and other water-handling equipment from damaging corrosion. The standard heater, equipped with an internal spray-type vent condenser, provides substantial savings in headroom and maintenance.

It pays to discuss your deaeration problems with Elliott engineers when planning new construction. For complete information write Elliott Company, Jeannette, Pa.

ELLIOTT Company



This weather-protected outdoor Elliott deaerating feedwater heater has 1,000,000 lb-per-hr capacity. At lower left is an Elliott 20,110 lb-per-hr evaporator preheater.

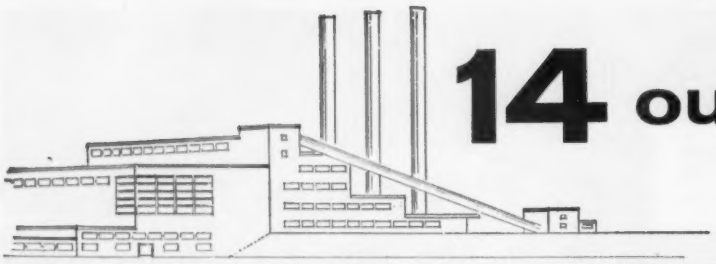


These two Elliott vertical deaerating feedwater heaters, each rated 40,000 lb per hr, serve a medium-sized plant. Shown also is one of two Elliott 3000-kw turbine-generators.

Ask for Bulletin N-18 on the Science of Deaeration

N 7-2

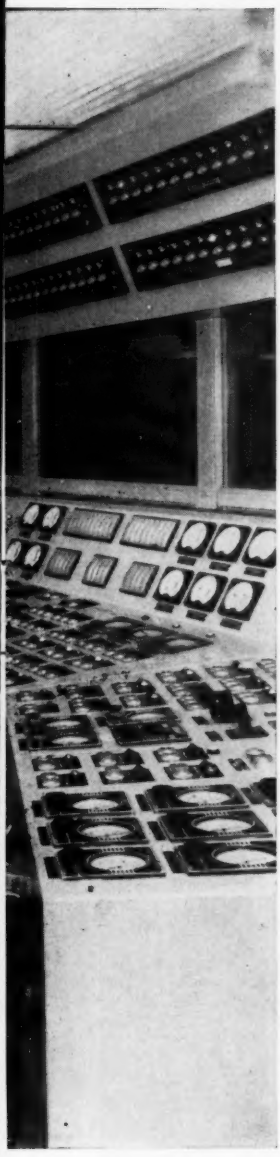
STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS



14 out of the 15

The steam control room for units 3 and 4 of the Eastlake Plant of The Cleveland Electric Illuminating Company. Eastlake uses Bailey Meters and Bailey Controls for Combustion, Feed Water and Steam Temperature. The FPC reported a 1955 heat rate at Eastlake of 9,336 Btu per kwhr, making it the seventh most efficient plant in the United States.

"most efficient*" plants use Bailey Meters and Controls



How's that for a vote of confidence! In the electric power industry, quality and dependability of equipment are paramount and 14 out of the top 15 power stations on the FPC's 1955 list chose Bailey Meters and Controls. Nine of these 15 chose Bailey equipment exclusively!

For breadth of product line, depth of experience, size and quality of field service organization, no one offers more to the power industry than Bailey. And the time to contact Bailey is during the early planning stage, when our recommendations can save time, trouble and money. Our engineers are at your service.

* 15 MOST EFFICIENT PLANTS

1955 Heat Rates Reported by FPC

	Btu/kwhr	Meters	Comb. Cont.	Feed Water Cont.	Steam Temp. Cont.
1. Kyger Creek (Ohio Valley Electric Corp.)	9,110	B		B	B
2. Clifty Creek (Indiana-Kentucky Electric Corp.)	9,143	B	B	B	B
3. Kanawha River (Appalachian Electric Power)	9,151	B	B	B	B
4. St. Clair (Detroit Edison Co.)	9,220	B	B	B	B
5. Muskingum River (Ohio Power Co.)	9,234	B	B	B	B
6. Tanners Creek (Indiana & Michigan Electric Co.)	9,273	B	B	B	B
7. Eastlake (Cleveland Electric Illuminating Co.)	9,336	B	B	B	B
8. Philip Sporn (Ohio Power Co.)	9,341	B	B	B	B
9. Shawville (Pennsylvania Electric Co.)	9,368	B			B
10. Albany (Niagara Mohawk Power Corp.)	9,373				
11. El Segundo (Southern California Edison Co.)	9,417	B	B	B	B
12. Oak Creek (Wisconsin Electric Power Co.)	9,480	B	B	B	B
13. Kearney "B" (Public Service Electric & Gas Co.)	9,511	B		B	B
14. Dunkirk (Niagara Mohawk Power Corp.)	9,523	B	B	B	
15. Cromby (Philadelphia Electric Co.)	9,540	B		B	B

B — Bailey installation

A130-2

Instruments and controls for power and process

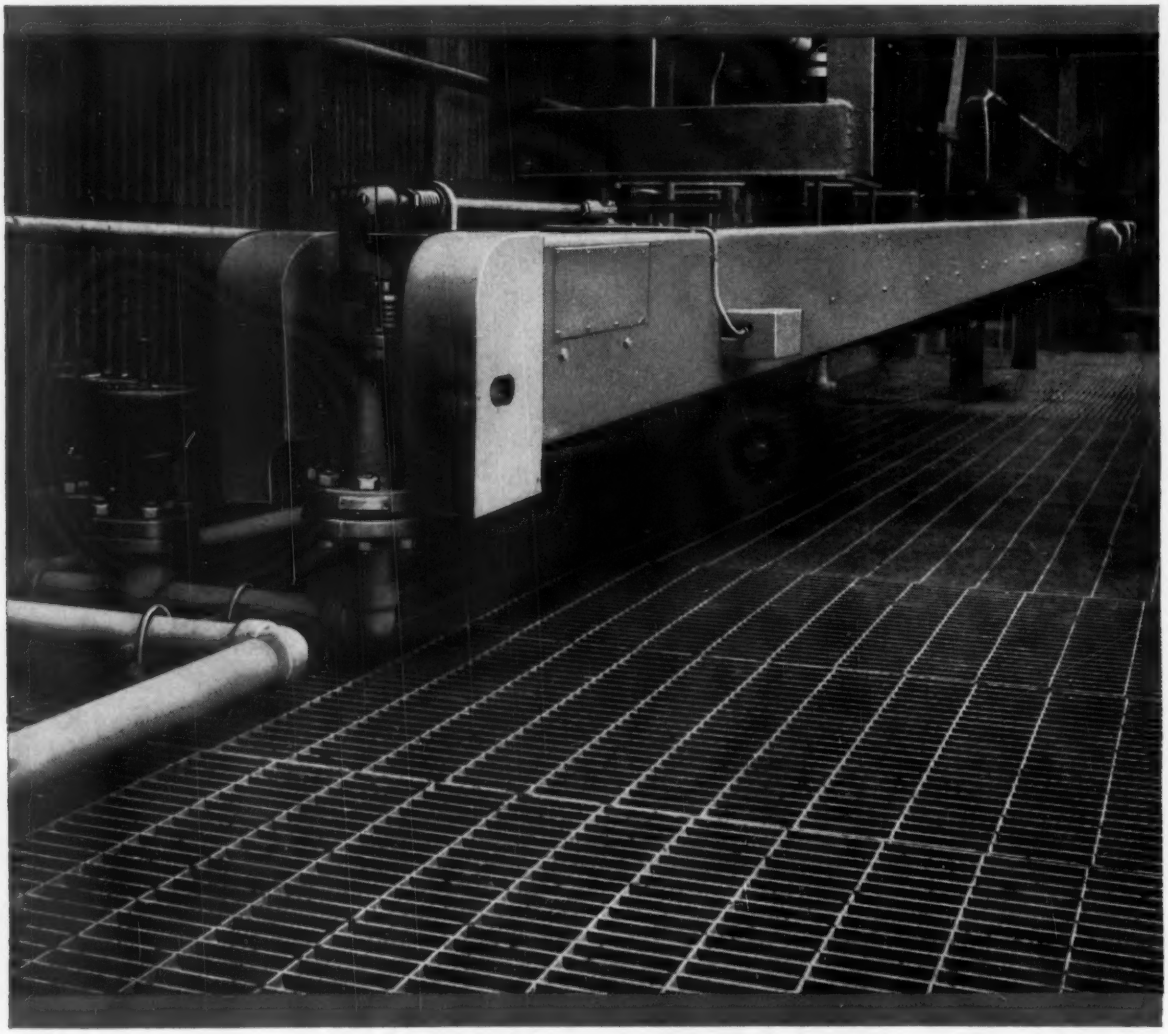
BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada — Bailey Meter Company Limited, Montreal

BAILEY METERS

Vulcan T-30 long cover record at Meramec Station!



This Vulcan T-30 long retractable soot blower has been in operation on Unit 1 at Meramec Station since May, 1956. Fuel for the Combustion Engineering boiler is pulverized coal. Burners are arranged for tangential firing and can be tilted for superheat control.

C-3447

retracts distance

A Vulcan T-30 long retractable soot blower is reaching more than 35 feet between two banks of the pendent secondary superheater on Boiler No. 1 in Meramec Station of Union Electric Company of Missouri. This Vulcan T-30 requires only one outboard hanger to support the extra-rugged framework. Lance travel and rotation are non-synchronized through two driving motors to produce a multi-helix cleaning path to cover different areas of the tube bank while extending and retracting.

Performance of this Vulcan T-30, which is located at the furnace exit where temperatures average 1910 degrees F., led to the selection of Vulcan T-30 blowers with 36-foot travel, RW-3E wall deslaggers and E-4-E rotaries—all under automatic-sequential control—for Meramec's new Unit 3, a Foster Wheeler boiler with separate furnaces, rated at 1,850,000 pounds per hour at 2150 psig and 1010 degrees F., with reheat to 1010 degrees F.

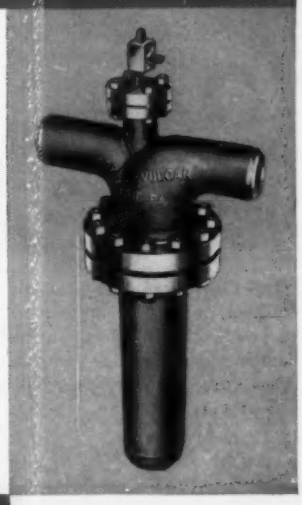
Whether your boiler is large or small, power or process, modern Vulcan soot blowers will help keep it operating at peak efficiency. Your Copes-Vulcan representative has the ideas, information and experience to help you choose the system best suited to your needs.

COPES VULCAN

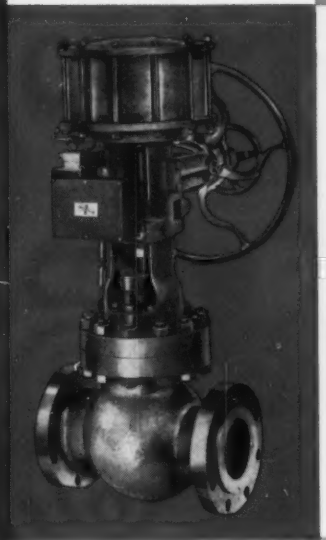
BLAW-KNOX

COPES-VULCAN DIVISION
BLAW-KNOX COMPANY
ERIE 4, PENNSYLVANIA

C-V NEWS NOTES



Copes-Vulcan Steam-Assist Desuperheater meets all specifications for conventional steam-atomizing type, yet normally uses assisting steam only on light loads where control is most difficult. Furnished with carburetor body as shown, or for in-line installation. Simple mechanical-atomizing types are also available. Bulletin 1024-A.

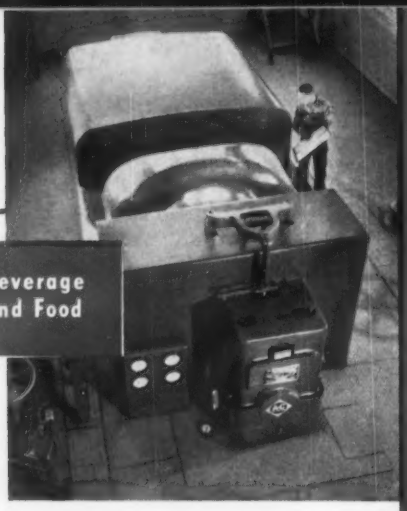


Unlimited pressures and sizes up to 16-inch, plus simplified design, are features of the new Copes-Vulcan Types CV-D and CV-P valves. Either diaphragm or piston types are available for pressure, temperature or liquid level control. Bulletin 1027.

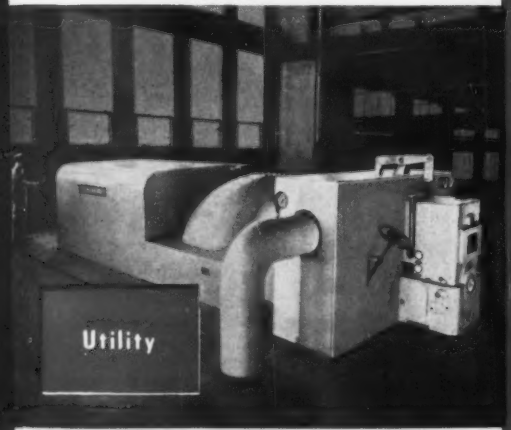
Bulletin 1030 illustrates and describes the Vulcan T-30 long retractable soot blower, now successfully operating in temperatures up to 2150 degrees F. (radiant). Your Copes-Vulcan representative can give you a copy, or write direct to the factory.

ALLIS-CHALMERS STEAM

The Choice of



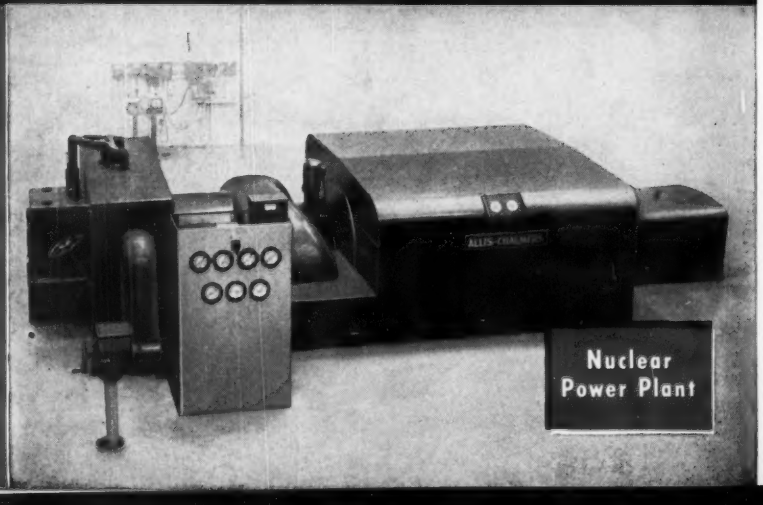
ONE OF THREE Allis-Chalmers steam turbine generator units in a large brewery. This 5000-kw condensing, automatic extraction, impulse unit generates electricity as a by-product of process steam.



A MINNESOTA CITY supplies business district and residential heating steam, and electric power with this recently installed 7500-kw condensing, automatic extraction steam turbine generator unit.

LARGE QUANTITIES of steam are required for heating, laundry, and other services. These 3000-kw Allis-Chalmers non-condensing, automatic extraction turbine-generator units supply steam at two pressures as well as electric power.

THIS 5000-kw condensing steam turbine generator unit was designed to meet the special requirements of a nuclear power plant. In addition, Allis-Chalmers supplied the switchgear, condenser, pumps, motors and other auxiliaries.



TURBINE GENERATOR UNITS

Modern Power Plants

Condensing . . . non-condensing and automatic extraction units are available for wide range of services

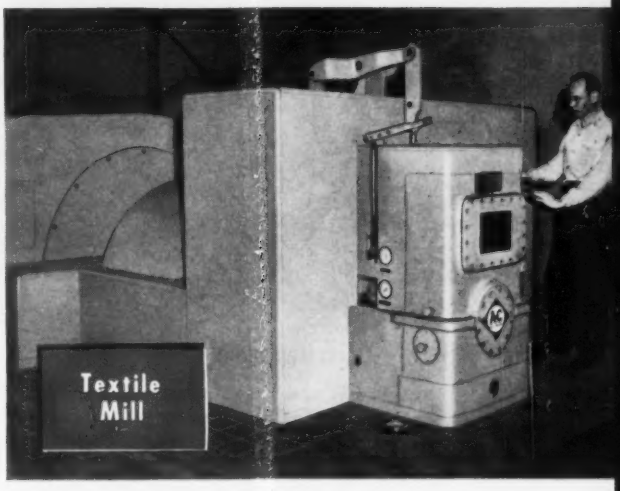
UTILITIES, breweries, textile mills, medical institutions, and a nuclear power plant enjoy the low installation and operating costs of Allis-Chalmers WA-Series steam turbine generator units.

These modern, compact units complement the most modern plant design. They are built in NEMA ratings through 10,000 kw . . . AIEE-ASME preferred ratings to and including 16,500 kw.

Users of these Allis-Chalmers turbines enjoy an important advantage. "Big turbine" features are incorporated in their design.

For example, the centrifugal-type speed governor is the same type used in large Allis-Chalmers steam turbines. Steam seals are the same labyrinth type used in turbines up to 300,000 kw. Removable external glands, high chrome alloy steel buckets and nozzles are other features. The 16,500-kw units with hydrogen-cooled generators have the same type of hydrogen seals as used on the large sizes.

Unit shipment with rotors individually locked in place cuts installation time and cost. Foundation cost is reduced because oil piping and generator air coolers are above the floor line.



PROCESS STEAM in a synthetic yarn plant produces electric power as a by-product with this 5000-kw non-condensing steam turbine generator unit.

GET MORE FACTS on these economical units. Call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-5437

ALLIS-CHALMERS

Introducing FISHER ELECTRO-

TYPE 340

Recent trends toward electrical control loops have created a need for final control elements capable of utilizing their greater sensitivity and speed. Fisher Electro-Hydraulic Operators are self-contained, electrically operated valve actuators, ideal for use in such control loops. They produce high performance without the use of electronic amplification, utilizing only a simple DC electrical circuit to control the hydraulic pilot. The pilot systems incorporate no close fitting parts, but use simple nozzle-flapper combinations to control hydraulic pressure.

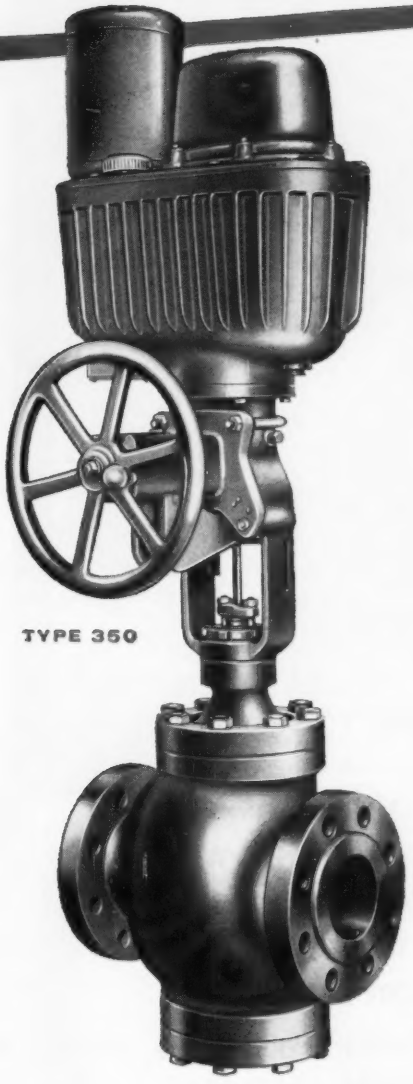
Two sizes are available. To handle the most demanding control jobs Type 350 has a maximum stem thrust of 2000 pounds and is available for use on valve sizes ½" to 16" with strokes from ½" to 3". Type 340 is designed for the average control job. It has a maximum stem thrust of 600 pounds and is available for use on valve sizes ½" to 4" with strokes from 7/16" to 1½".

Rugged, simple design plus accurate, dependable performance, make the FISHER Electro-Hydraulic Operators the outstanding electric final control elements available.

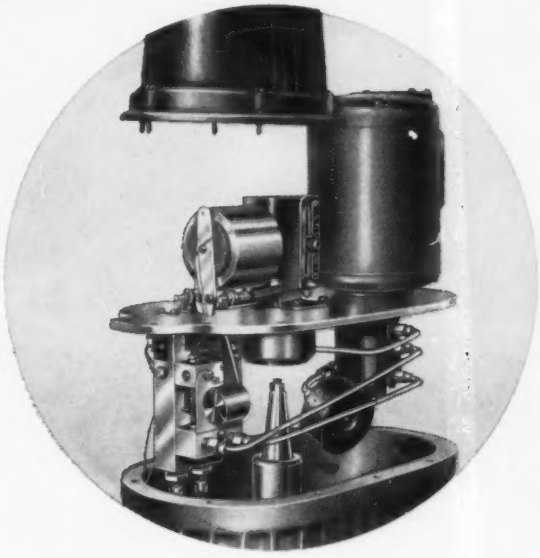
WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND

FISHER GOVERNOR COMPANY

HYDRAULIC OPERATORS



TYPE 350



TYPE 340

- Adaptable to all DC output signals
- Requires only zero and travel adjustment (both readily accessible)
- Stroking range from 7/16" to 1½"
- Stroking speed 0.1"/sec.
- Resolution sensitivity—0.2% of input range
- Maximum stem thrust 600 pounds
- Operates on simple DC—no electronic amplification
- Valve sizes from ½" to 4"

TYPE 350

- Adaptable to all DC output signals
- Requires only zero and travel adjustment (both readily accessible)
- Stroking range from ½" to 3"
- Stroking speed 0.37"/sec.
- Resolution sensitivity—Better than 0.05% of input range
- Maximum stem thrust 2000 pounds
- Operates on simple DC—no electronic amplification

Valve sizes from ½" to 16"

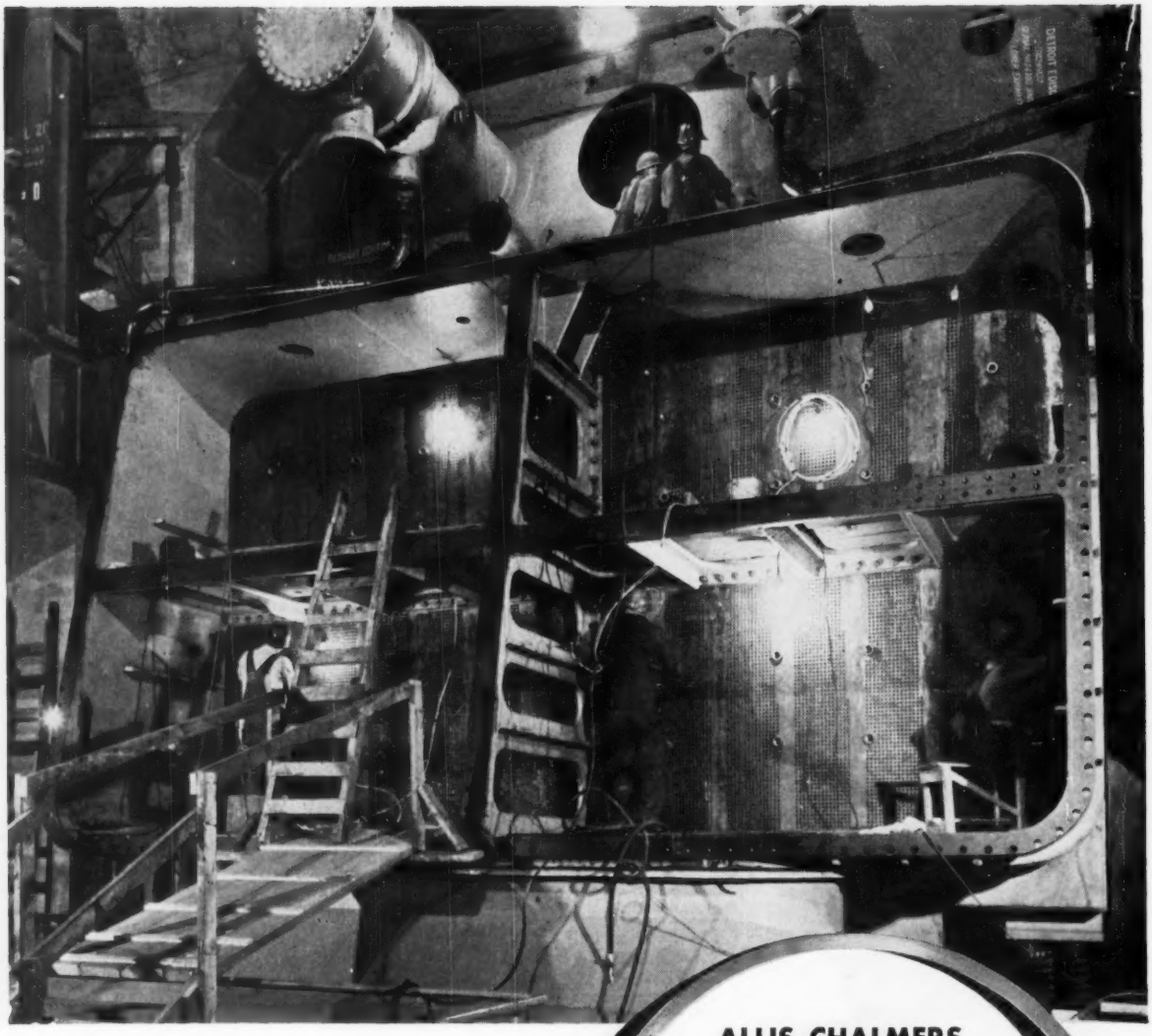
LIQUID LEVEL CONTROL

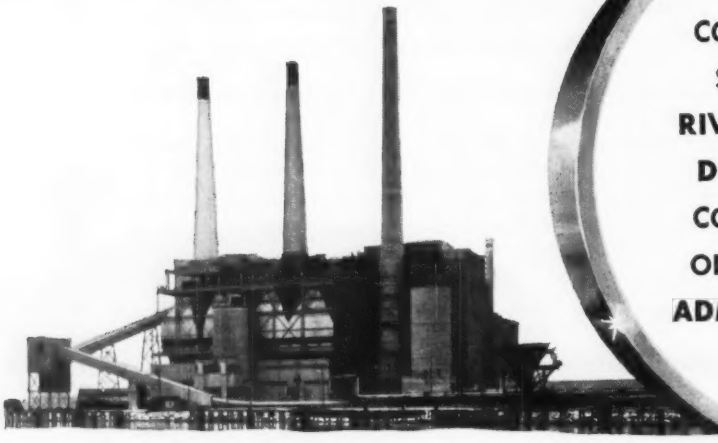
FISHER® Controls

SINCE 1880

Marshalltown, Iowa / Woodstock, Ontario

The bigger the condenser the





ALLIS-CHALMERS CONDENSER THAT WILL SERVE THE #2 UNIT, RIVER ROUGE STATION, DETROIT EDISON CO., CONTAINS 249,000 LBS. OF REVERE ARSENICAL ADMIRALTY CONDENSER TUBES

more it needs the dependability of

Revere Quality Tubes

When condensers get to be the size of this one made by ALLIS-CHALMERS (even bigger ones are now being constructed) owners can't afford the luxury of failure.

In order to leave nothing to chance, engineers of the Detroit Edison Company consulted with Revere Technical Advisors on the operating conditions under which the tubes would have to give service. Many different alloys were considered. The final decision was Revere Arsenical Admiralty Metal for the Tubes and Muntz Metal for the Tube Plates.

This final decision was based on a combination of the experience of Detroit Edison Engineers and Revere's wide experience in the condenser tube field, and the tremendous amount of research and laboratory work done in determining the relative corrosion resistance of the different alloys under a wide variety of operating conditions.

Since there are variable factors in practically every condenser tube installation, why not take advantage of this storehouse of facts and consult with Revere's Technical Advisory Service before making your tube commitments?

Revere furnishes plates, from the smallest to the largest sizes, in Cupro-Nickel, Copper, Herculoy, Muntz Metal, Naval Brass and Admiralty, and tubes in Cupro-Nickel, Aluminum Brass, Admiralty, Herculoy, Arsenical Copper, Muntz Metal and other alloys.

PLACING ONE OF THE 19,850 TUBES in the condenser for the new 265,000 KW turbine generator unit #2 at the River Rouge Station of DETROIT EDISON COMPANY. Tubes are ¾" O.D. x 18 BWG x 30' long and are Revere Arsenical Admiralty Metal. Tube sheets are Revere Muntz Metal. A lasting combination!

REVERE COPPER AND BRASS INCORPORATED

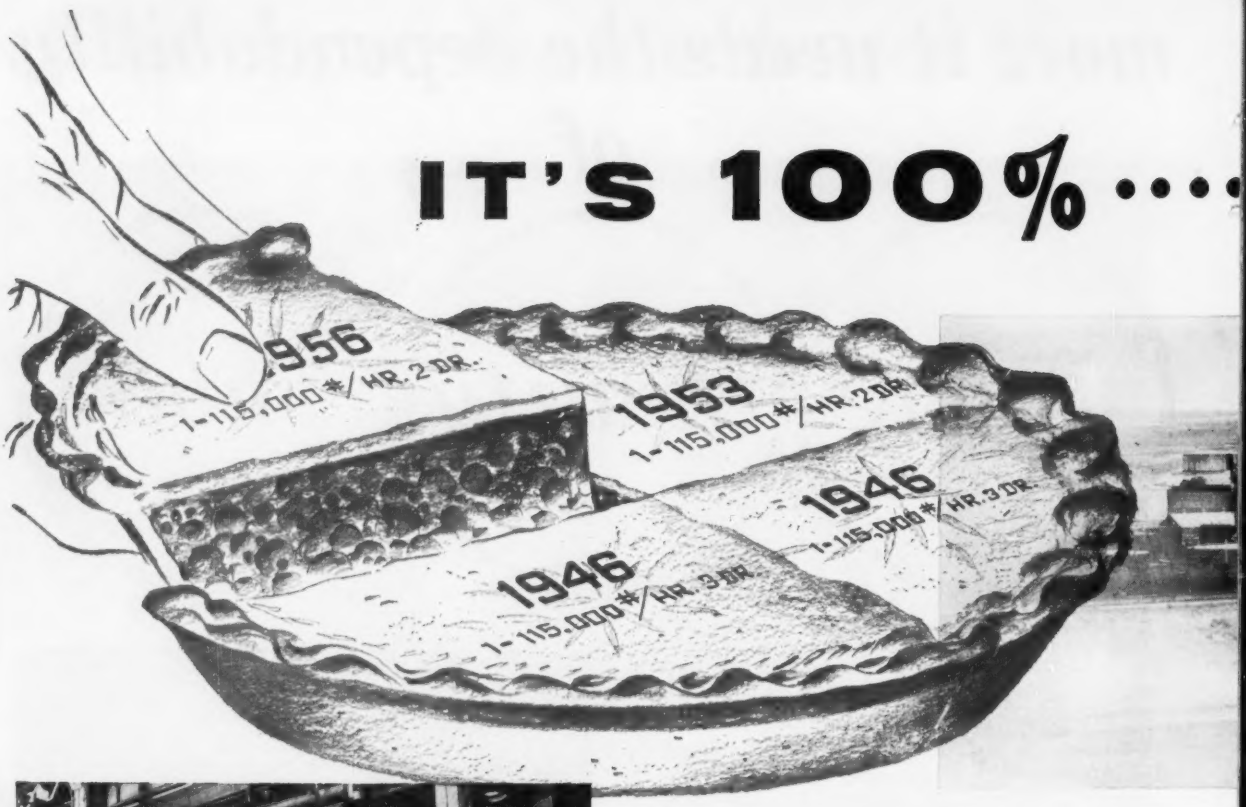
Founded by Paul Revere in 1801

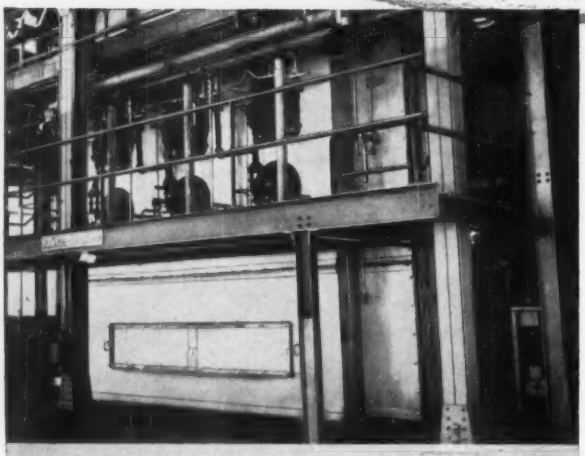
230 Park Avenue, New York 17, N. Y.

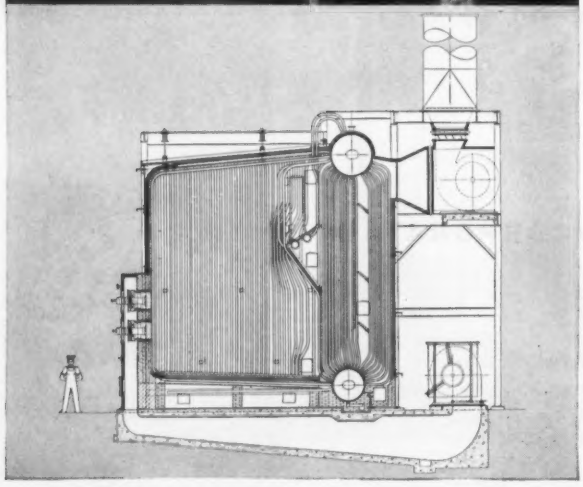
Mills: Rome, N. Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities, Distributors Everywhere.

COPPER ★ BRASS ★ REVERE ★ ALUMINUM 1801

IT'S 100% ....







2 Repeat Orders make it 100% Erie City at Casper, Wyoming

1946

2 — 115,000 lbs./hr. steam generators

1953

1 — 115,000 lbs./hr. steam generator

1956

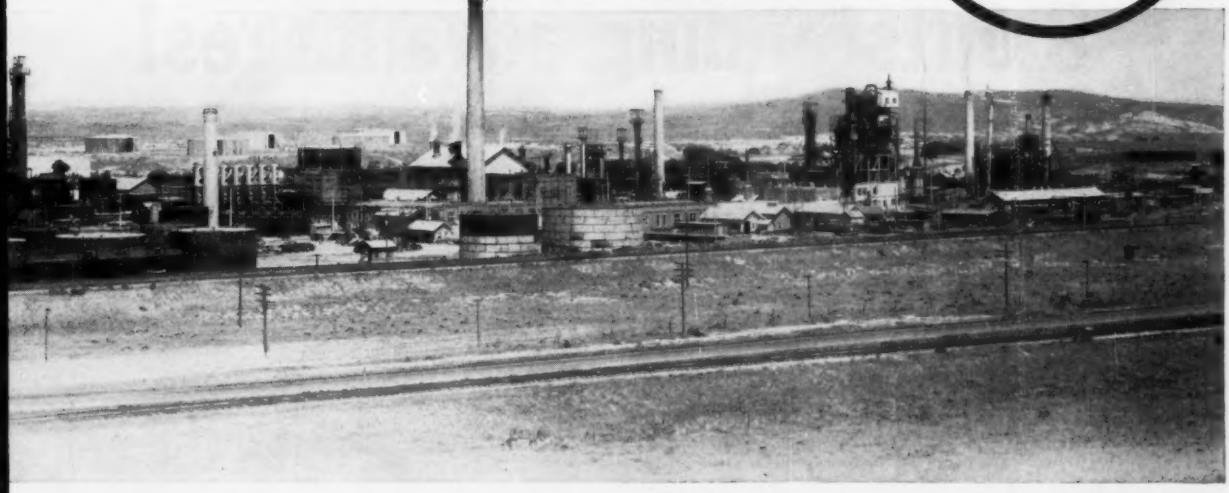
1 — 115,000 lbs./hr. steam generator

Significant Data:

Boiler Capacity	115,000 lbs./hr.
Operating Pressure	225 lbs.
Design Pressure	250 lbs.
Total Temperature	450° F.
Superheaters	Erie City
Firing	Oil and Gas

ERIE CITY at CASPER, WYOMING

TEXACO
REG. T. M.



Water Conditions ... Tough
Steam Quality ..... Tops

• Proof of the pie is in the eating. In 1946 the Texas Company of Casper, Wyoming installed two 115,000 lbs./hr. boilers, liked what they got, and came back for more in 1953 and 1956. Repeat business is good business because it shows customer satisfaction.

Especially gratifying were these repeat orders because they involved working with tough water conditions. Starting with river water — high in hardness and containing abnormal quantities of dissolved and suspended solids — the properly designed Erie City steam separators, steam scrubbers and boiler layouts produce top quality, clean, dry steam.

Such repeat business results from a thorough understanding of the problem and the application of sound engineering, top quality materials and skilled workmanship. Investigate the use of Erie City Steam Generating equipment in your plant — write for Bulletin SB-502K

ERIE CITY
117 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS PULVERIZERS

In Iron Body Wedge Gate Valves,
Outside Screw and Yoke Design,

Walworth offers you these 8 outstanding advantages!

STRONGER CONNECTIONS. T-head disc-to-stem connection on OS&Y types permits wedge to properly seat itself.

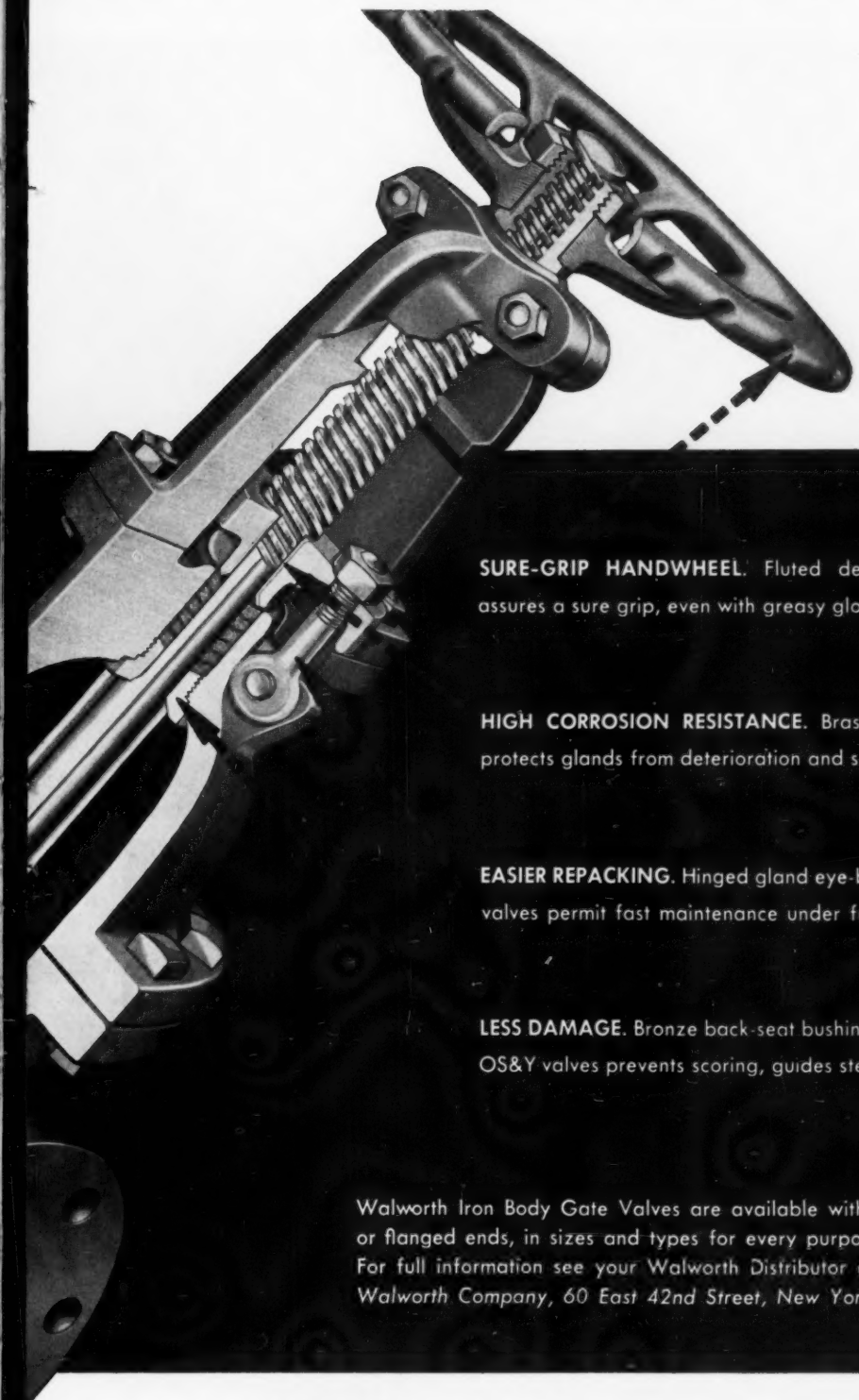
TIGHTER SEAL. Solid web type disc on OS&Y valves provides tight closure, greater strength and longer service.

REDUCED TURBULENCE. Fluid action is minimized due to this straight-flow port design.

FEWER OBSTRUCTIONS. Seat rings of bottom-seated types are screwed into body to prevent gum and grit accumulations.

*WALWORTH is a registered trademark of WALWORTH COMPANY

Walworth Subsidiaries: ALLOY STEEL PRODUCTS CO. • CONOFLOW CORPORATION • GROVE VALVE AND REGULATOR CO.



SURE-GRIP HANDWHEEL. Fluted design assures a sure grip, even with greasy gloves.

HIGH CORROSION RESISTANCE. Brass liner protects glands from deterioration and scoring.

EASIER REPACKING. Hinged gland eye-bolts on OS&Y valves permit fast maintenance under full pressure.

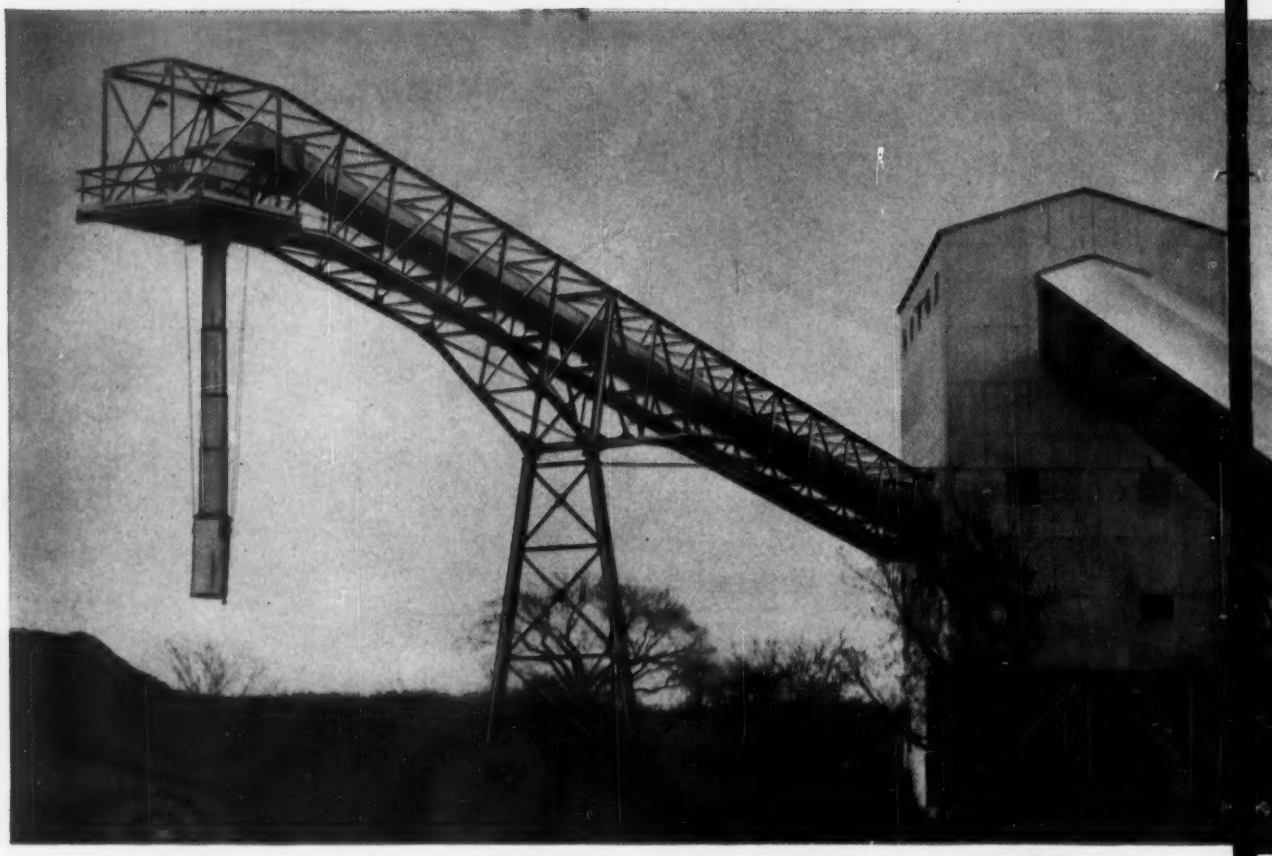
LESS DAMAGE. Bronze back-seat bushing in bonnet of OS&Y valves prevents scoring, guides stem accurately.

Walworth Iron Body Gate Valves are available with screwed or flanged ends, in sizes and types for every purpose.
For full information see your Walworth Distributor or write:
Walworth Company, 60 East 42nd Street, New York 17, N. Y.

WALWORTH*

DISTRIBUTORS IN PRINCIPAL CITIES THROUGHOUT THE WORLD

M & H VALVE & FITTINGS CO. • SOUTHWEST FABRICATING AND WELDING CO., INC. • WALWORTH COMPANY OF CANADA, LTD.



A section of a 300 TPH belt conveyor system at a midwest power station. Design permits future expansion which will double present capacity.

STEPHENS-

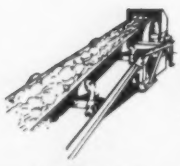
the name to call on for mechanized

Moving coal from a receiving point to combustion at lowest possible cost is a vital problem in central power stations, private industrial plants, service institutions —wherever coal is used for steam generation.

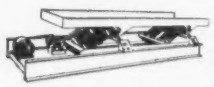
The trick in the moving is knowing how to apply modern, scientific conveying equipment to any given set of conditions. How will coal arrive at the plant? What are generation requirements? What specific types of handling equipment are needed? What are storage needs inside and out? STEPHENS-ADAMSON engineers probe the problem all the way. These same men know there is no such thing as a "typical" power plant conveyor system. It must be designed purely to meet existing conditions and with plenty of foresight for future demand.

To provide the tools the engineer needs, STEPHENS-ADAMSON manufactures a complete line of coal handling equipment. It is a quality line designed from long experience, built to last for years of trouble free service.

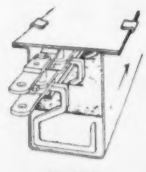
For the ultimate economy in coal handling systems, see the STEPHENS-ADAMSON representative in your area. Learn why it pays to convey the S-A way.



BELT CONVEYORS

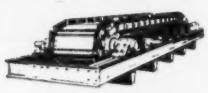


VIBRATING CONVEYORS



REDLER
CONVEYORS, ELEVATORS

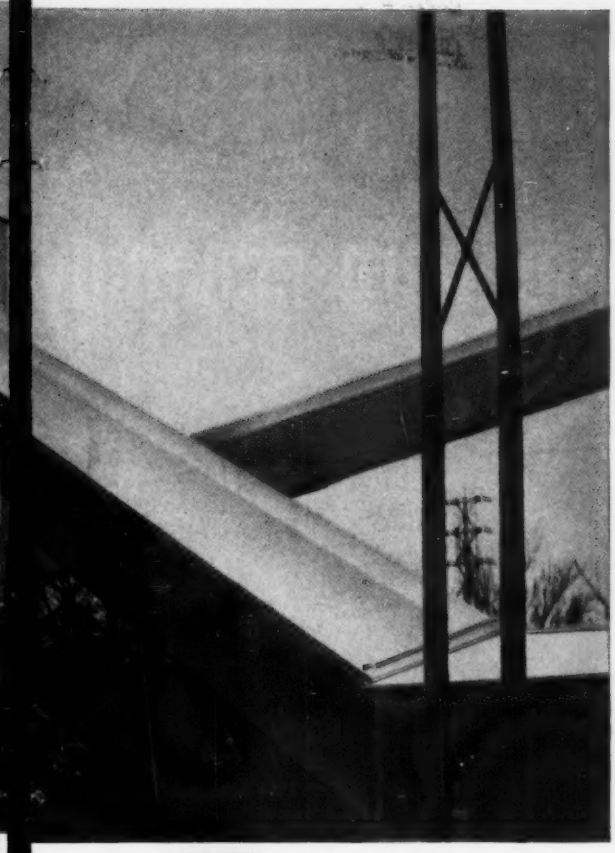
ZIPPER
CONVEYOR-ELEVATORS

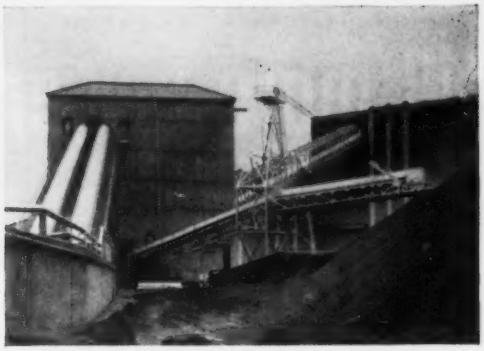


PAN CONVEYORS

BUCKET
ELEVATORS

BIN GATES—
ALL KINDS





An S-A system serves the needs of the Potomac Electric Power Co., Washington, D.C. Existing facilities have been designed with provision for ultimate 493,000 KW output.

Brantly Steam Station, Danville, Va., is served by an S-A conveyor system. Compact REDLER conveyor-elevators are used to good advantage to convey coal to silo and stockpile storage. A pan feeder serves to move coal from track hopper and also reclaims from storage pile.

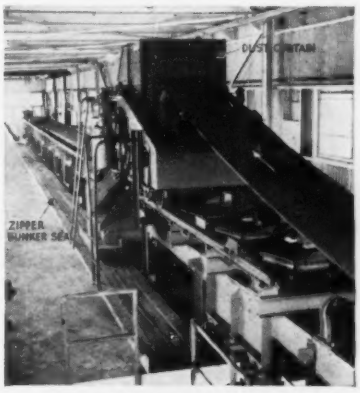
S-A ADAMSON

economy in coal conveyor systems

S-A manufactures a wide range of material handling products in three complete plants in U. S. and Canada.

Belt Conveyors
Belt, Pan & Plate Feeders
Ship Loading Boom Conveyors
Stacking Conveyors
Storage & Reclaiming Systems
"Natural Frequency" Vibrating Conveyors
REDLER Conveyor-Elevators
ZIPPER Conveyor-Elevators
Conveyor Belt Cleaners
Headshaft Holdbacks
Grizzlies & Screens
Centrifugal Pilers
Bin Gates & Tunnel Gates
Car Pullers & Spotters
Bucket Elevators
Skip Hoists
SEALMASTER Ball Bearing Units

• *Write for a bulletin on any of the above products.*



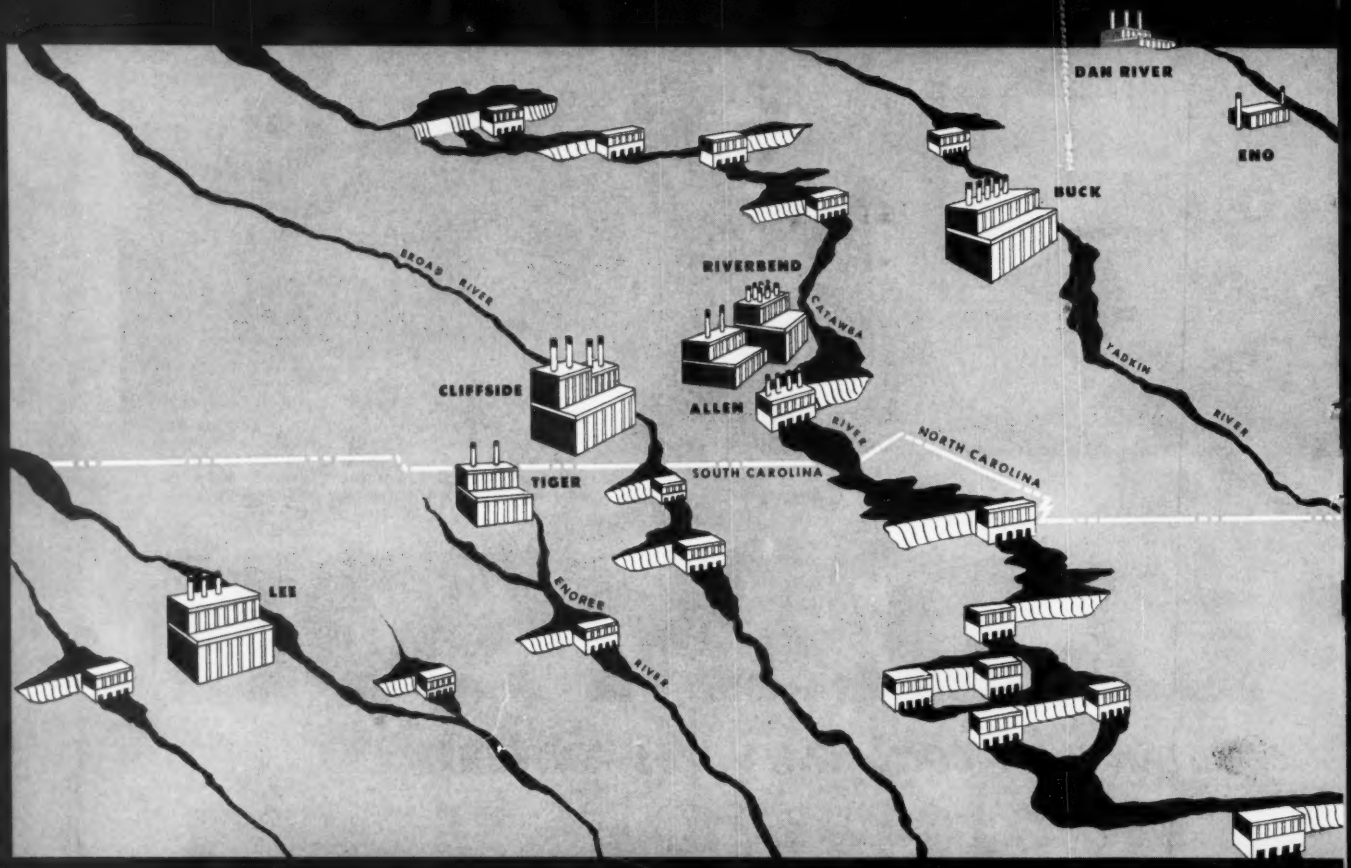
A self-propelled tripper is used by the Carolina Power and Light Company, Wilmington, N.C., to discharge coal from a belt conveyor into a zipper bunker. Zipper bunker seal prevents dusting.

SINCE 1901 S-A STEPHENS ADAMSON MFG. CO.

STEPHENS-ADAMSON MFG. CO.

5 RIDGEWAY AVENUE, AURORA, ILLINOIS
LOS ANGELES, CALIFORNIA
BELLEVILLE, ONTARIO

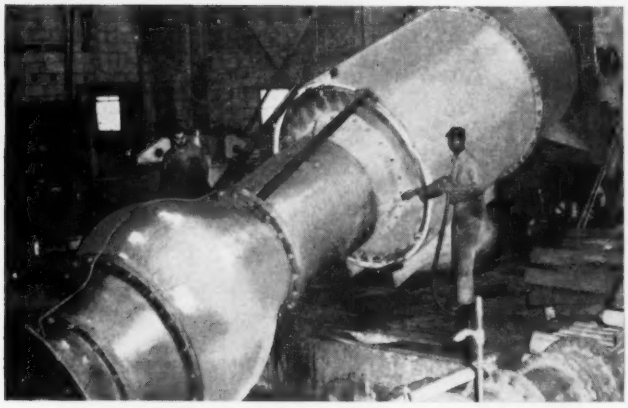
Still more power for DUKE POWER... and the fast-growing Southern economy



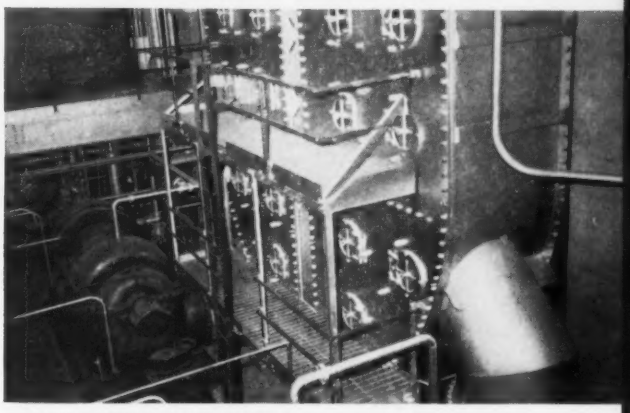
1,844,300 sq. ft. of C. H. Wheeler Surface Condensers are in use now or on order in the Duke Power System:

Station	No. of Condensers	Total Sq. Ft. Condensing Surface
ALLEN	4	530,000
BUCK	5	246,300
CLIFFSIDE	4	163,000
DAN RIVER	3	195,000
LEE	3	240,000
RIVERBEND	7	470,000
	26	1,844,300

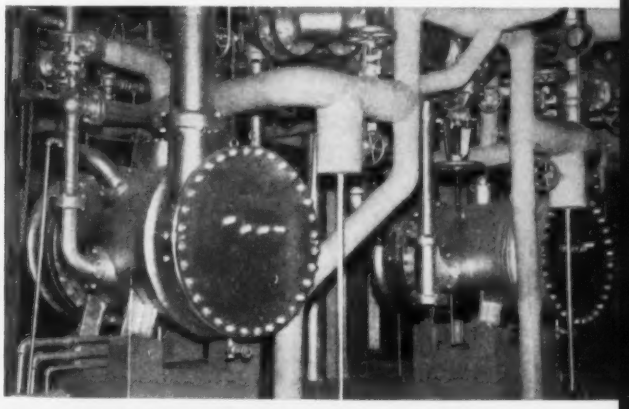
It's one of the south's greatest private power expansion programs—and C.H. Wheeler of Philadelphia is playing a leading part in it. To date, Wheeler has installed or is building 26 Dual Bank Surface Condensers, 5 Low Level Jet Condensers and a vast quantity of other power plant equipment. On the left is the story in tabular and geographic form; on this page are typical installation photographs of Wheeler equipment at Duke.



50-TON CIRCULATOR is one of 2 such pumps at Allen Plant Unit No. 1. It's a 48" x 54" Pull-Out Type Vertical Mixed Flow Pump. Capacity is 46,000 gpm. Two more of these pumps are being installed at Allen Plant Unit No. 2. The Allen Plant is the first plant in the Duke Power System to use vertical condensate pumps and circulating water pumps made by Wheeler.



AT DUKE POWER'S BUCK STATION are two C.H. Wheeler Dual Bank Surface Condensers with 75,000 sq. ft. of cooling area each. Wheeler Circulating Water Pumps are also in service at this Spencer, North Carolina Station. Other Surface Condensers at the Buck Station range in condensing area from 5000 sq. ft. (a house turbine unit) to 60,000 sq. ft.



C.H. WHEELER'S TWO-STAGE TUBEJET® Air Ejector (above) shown at Duke Power's Buck Station. These same type units have been used successfully at other power generating plants for over 30 years, with only routine maintenance. First cost and installation cost are low, installation is fast and operation simple.

ONE OF TWO 7-STAGE SPLIT CYCLE 18" x 10" Vertical Condensate Pumps (left) for Duke Power's Allen Plant Unit No. 1 ready for test. Each unit is rated at 2000 gpm against a 620-ft. total dynamic head at 880 rpm. The first three stages operate as a unit at 225-ft. head; the other four stages of each Condensate Pump operate as a booster pump at head of 395 ft.

C. H. Wheeler Mfg. Co.

19TH & LEHIGH AVENUE *Philadelphia 32, Pennsylvania*

Steam Condensers

Vacuum Equipment

Centrifugal, Axial & Mixed Flow Pumps

Marine Auxiliary Machinery

Nuclear Products

The Yarway Impulse a new era in steam

. . . it began in 1935, when Yarway applied a unique principle of thermodynamics to steam traps—and the Yarway IMPULSE Steam Trap was born.

Since then over 1,225,000 Yarway IMPULSE traps have proved themselves so well in service that today many other type traps are regarded as obsolete—an understandable reason why the Yarway IMPULSE type of steam trap is being imitated.

To industry, the Yarway IMPULSE trap makes possible a new high in thermal efficiency of equipment, a new low in trap operating maintenance . . . resulting in increased production and higher profits for the user.

THE THERMODYNAMIC PRINCIPLE

This is the principle on which the Yarway IMPULSE trap design is based—that variations in temperature of water discharging through two orifices in series cause variations in pressure in an intermediate chamber between the orifices, and that these changes in pressure may be utilized to open and close the trap valve.

ONE MOVING PART

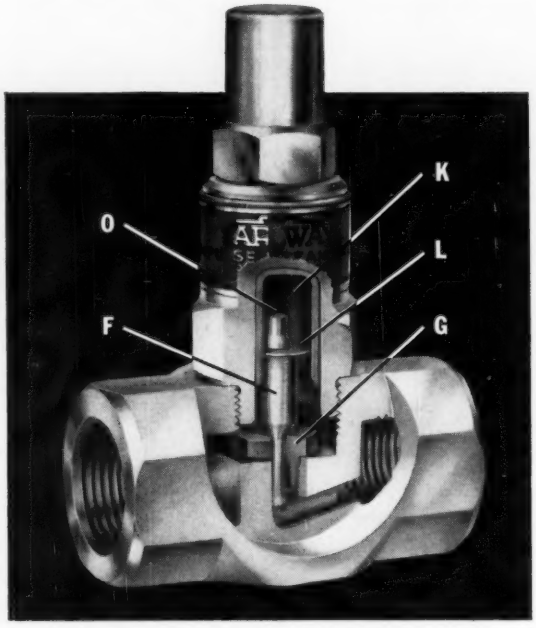
There is only one moving part in a Yarway IMPULSE trap—a small, stainless steel valve. If needed, the entire valve assembly can be replaced in 5 or 6 minutes. It is the simplest of all steam traps to service.

EQUIPMENT HOTTER, SOONER— STAYS HOT

At "start up" the little valve opens wide to discharge air and condensate continuously. This brings equipment into production in the quickest possible time. The valve then actually floats on the condensate load, opening at intervals to discharge each bit of condensate as it forms, maintaining highest, steady temperatures.

HOW IT WORKS

When steam is turned on, condensate and air flow into trap, exerting pressure on underside of control disc L, raising valve F and allowing full discharge through valve seat G.



Meantime, tiny portion of condensate flows around control disc L into control chamber K and discharges through orifice O in the center of valve. This keeps pressure low in chamber K until condensate approaches steam temperature. Some of this hot condensate now begins to flash in control chamber and on downstream side of control orifice O. This chokes the flow through orifice O and pressure builds up in chamber K, snapping valve F shut.

When condensate cools slightly, flashing stops, relieving pressure in K and permitting valve to re-open. In practice, valve opens and closes at short intervals on ordinary condensate loads, remains wide open on heaviest condensate loads. Steam equipment is always kept at its peak operating temperature.

PLUS ADVANTAGES

Other advantages like the following have wide appeal to hundreds of thousands of users:

- Small size and light weight
- Easy, low cost installation
- Minimum maintenance
- Non-freezing
- Stainless steel construction
- No adjustment of valve or seat needed for any pressure
- Low initial cost

started trapping...

A YARWAY IMPULSE STEAM TRAP TO MEET EACH TRAPPING REQUIREMENT

Research and development in the Yarway Steam Laboratory, combined with intensive field testing, have produced a line of steam traps—*all* of the Yarway IMPULSE type . . . to specifically and efficiently meet each of the following classes of trapping service:

Normal requirements for pressures up to 600 psi are satisfied by Yarway Series 60 and 120 IMPULSE Traps in six sizes, ½" to 2".

Light loads for pressures up to 600 psi are handled most efficiently by the ½" Yarway No. 20-A and No. 120-A IMPULSE Traps.

Heavy loads for pressures to 600 psi call for the extra high capacity Series 40 Yarway IMPULSE Trap, available in five sizes, ½" to 2½".

Highest pressure and marine requirements up to 2500 psi are met by the Yarway Integral-Strainer IMPULSE Trap, in six sizes, ½" to 2", flanged, screwed and socket weld types.

NATIONALLY STOCKED, SOLD AND SERVICED

Over 270 Industrial Distributors, conveniently located in every industrial area, stock and sell Yarway IMPULSE Steam Traps . . . and over 35 Yarway field engineers throughout the country are available to help you select the right steam trap for the service and insure maximum efficiency on the job.

For free copy of new bulletin "*The Why and How of Steam Trapping*," write:

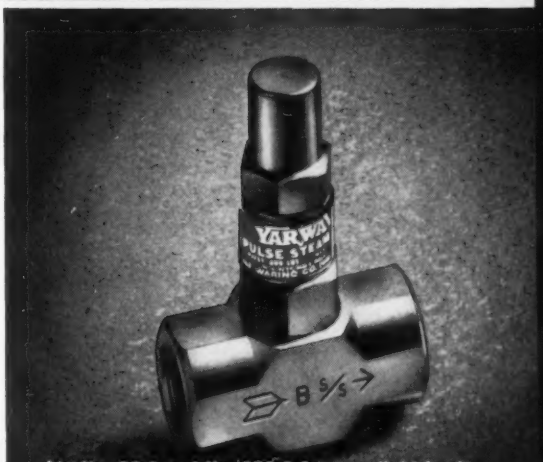
YARNALL-WARING COMPANY

100 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY *impulse*®

...a good way to specify steam traps

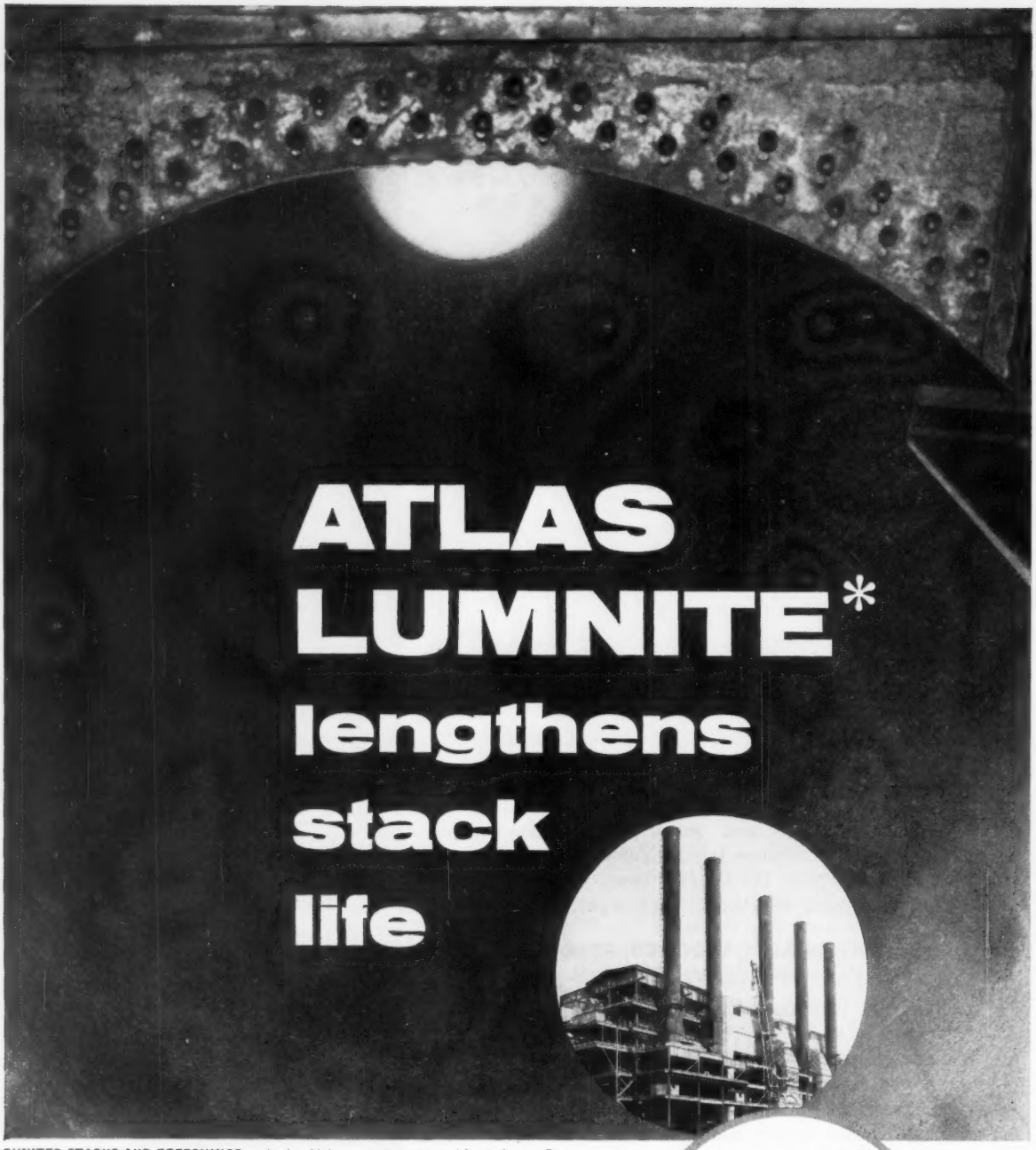
Series 60 and 120 for normal requirements.



½" No. 20-A and No. 120-A for very light loads.

Series 40 for very heavy loads.

Integral Strainer Impulse Traps for highest pressures and marine use.



GUNITED STACKS AND BREECHINGS at Linden, N. J., generating station of Public Service Electric and Gas Co. (Newark) are among the growing number of power-plant installations using concrete linings made with Lumnite cement. From ash hoppers to stacks, Lumnite linings reduce maintenance costs and provide long service life.

- Lumnite-made industrial concretes give rugged resistance to heat, corrosion, abrasion and thermal shock.
- Placement is fast and easy—by guniting, pouring or plastering.
- Downtime is reduced to a minimum—service strength is reached within 24 hours.

For maximum convenience, use Lumnite-made castables. These are packaged mixtures, ready for use. Just add water, mix and place. Made and distributed by leading manufacturers of refractories.

For more information, write: Universal Atlas, 100 Park Avenue, New York 17, N. Y.

* **"LUMNITE"** *is the registered trademark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

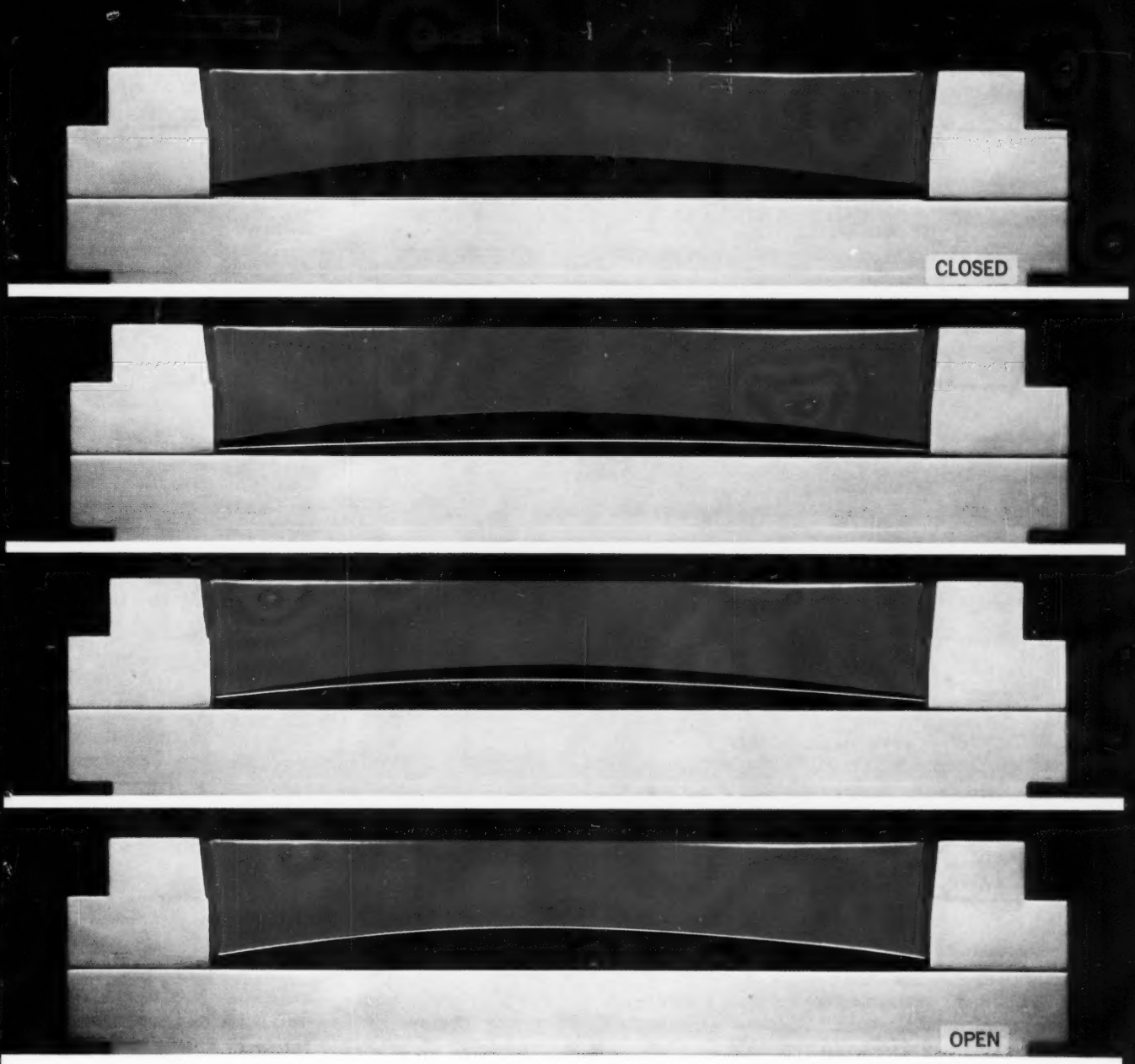
L-154

UNIVERSAL ATLAS CEMENTS

USS

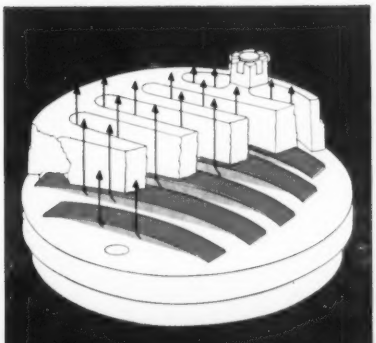
UNIVERSAL ATLAS CEMENT COMPANY—member of the industrial family that serves the nation—**UNITED STATES STEEL**

OFFICES: *Albany • Birmingham • Boston • Chicago • Dayton • Kansas City • Milwaukee • Minneapolis • New York • Philadelphia • Pittsburgh • St. Louis • Waco*



Key to Compressor Reliability . . .

WORLD'S SIMPLEST COMPRESSOR VALVE!



Stainless steel strips, in red, open the Feather Valve ports by rolling contact against the lower plate. There is no impact.

The Feather Valve* is the only compressor valve with no buffer plates or cushioning accessories. The strip is the only moving part and the valve itself is all but indestructible. The fastest-acting on the market, Feather Valves are standard equipment on all Worthington compressors.

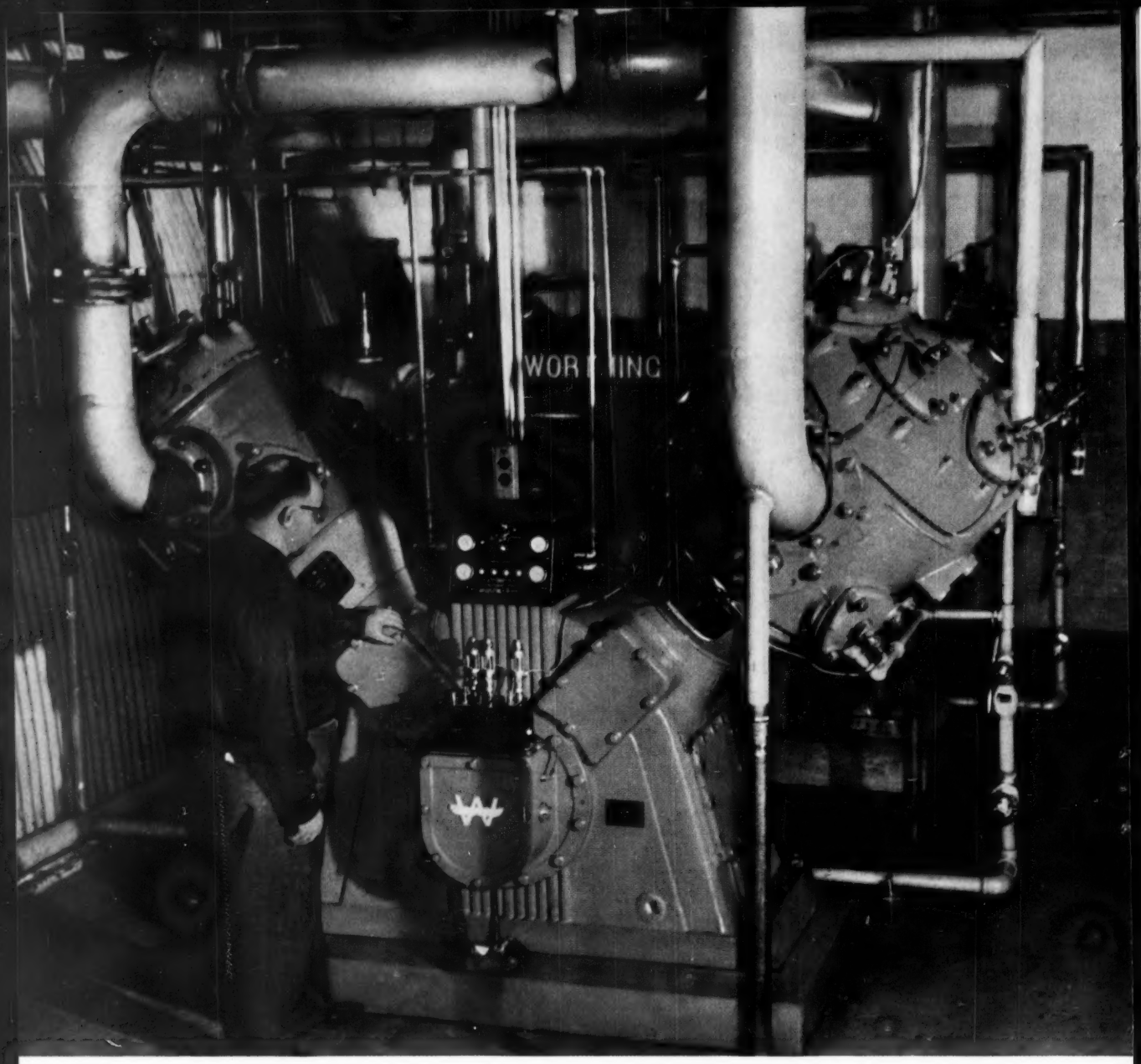
Their extremely fast action means you get virtually no slip or backflow. As a result Worthington compressors give you minimum valve loss and use minimum power.

No Impact. Combined with fast action is Worthington's exclusive "no impact" operation which assures long life and negligible maintenance. The flexible strips open and close with a gentle rolling contact.

For a first hand story of a Feather Valve's ruggedness, see the next page.

WORTHINGTON

*Reg. U. S. Pat. Off.



Feather Valve compressors at Twin Coach plant...

IMPROVE AIR SUPPLY, CUT MAINTENANCE

"This compressor installation cut maintenance costs and improved reliability," reports John Anthony, Twin Coach Company, Aircraft Division plant in Buffalo, New York. "We centralized our compressed air supply with installation of three heavy duty, water-cooled, 2-stage 100 psi Worthington Feather Valve compressors."

Constant-pressure, reliable air supply is the basic Twin Coach manufacturing power service. Regular scheduled preventive maintenance inspections (only four times per year) show that these compressors are giving entirely satisfactory performance.

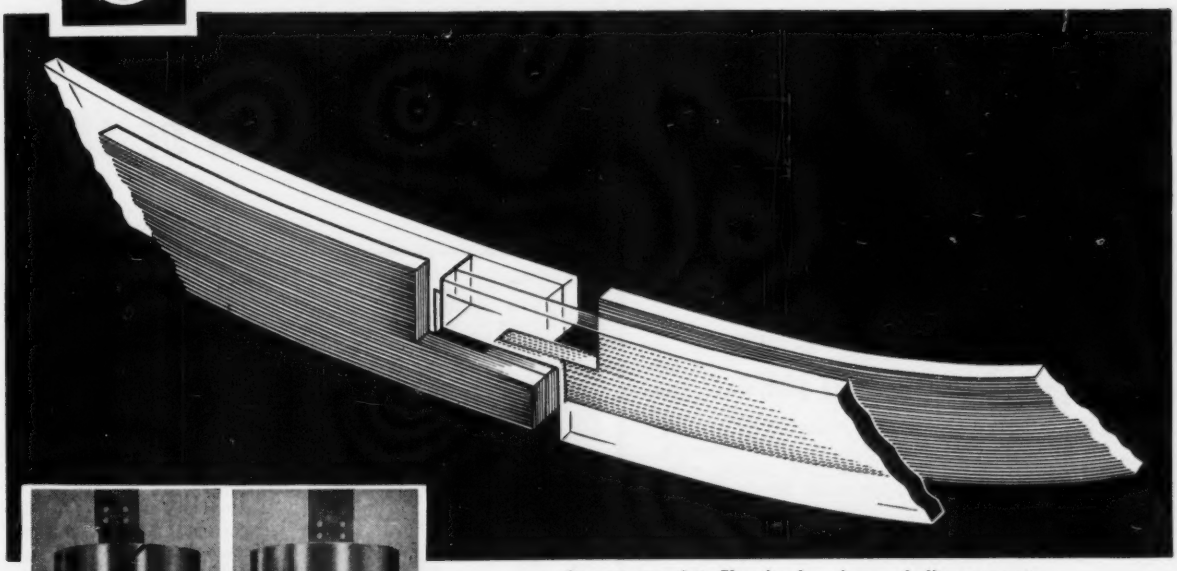
Valves are your key to compressor reliability. Feather Valves, interchangeable between compressor suction and inlet, are the surest acting, tightest, most flexible and fastest made. They are most reliable because they are simplest.

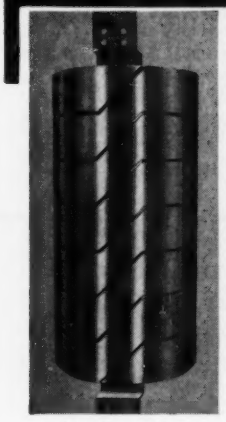
For information regarding your compressed air needs, contact Worthington Corporation, Section K-72, Harrison, New Jersey, stating requirements—or contact your local Worthington representative located in every major city.

WORTHINGTON

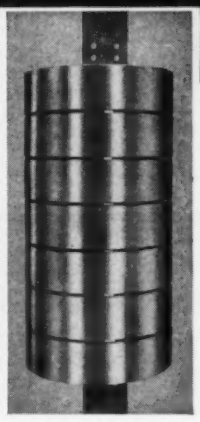
See preceding page

UNIT SUBSTATION TRANSFORMERS





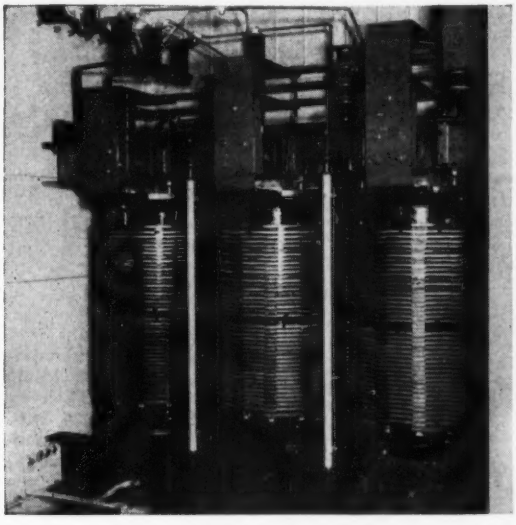
Diagonal connections between rings.



Crossover point on reverse side of transformer.

Crossover point. Showing how inner winding connects with outer winding at center of transformer secondary.

BRUTE STRENGTH SECONDARIES WOUND FROM SOLID BUS— NO MECHANICAL JOINTS



Completed dry-type transformer mounted in ventilated housing.

From one end of the secondary to the other in these I-T-E unit substation transformers, electricity flows through solid copper bus bar.

This is a unique design for high current secondary windings embodying great structural strength, plus low reactance and high conductivity. Lengths of copper bus, cut on a diagonal and formed into rings, are brazed together below the diagonal gap in such a manner as to form a continuous electrical winding.

Where greater current carrying capacity is required, two such windings are paralleled, but a crossover at the midpoint causes each of the parallel paths to have half its turns in the outer layer and half in the inner—equalizing the impedance of the two parallel paths and distributing the reactance evenly.

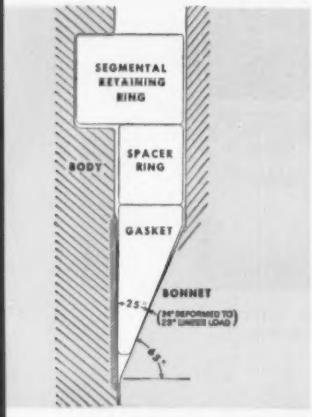
Write for complete information. I-T-E Circuit Breaker Company, Transformer & Rectifier Division, 19th & Hamilton Streets, Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

Transformer & Rectifier Division

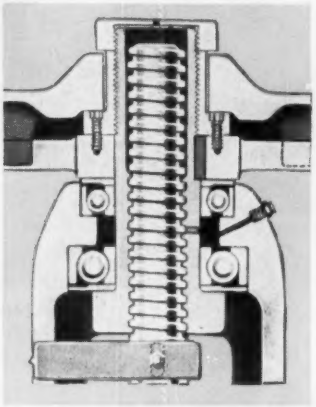
How To Get SPECIAL Features

Tips on selection, installation and operation of steel



NON-LEAK PRESSURE-SEAL BONNET JOINT

By changing bonnet-gasket angle from 45 degrees to shape shown, sealing area is increased 300%, sealing force doubled. Soft iron gasket is electroplated with a lead alloy which flows under pressure, assures tight seal. No sharp gasket edge to damage. Easily disassembled.

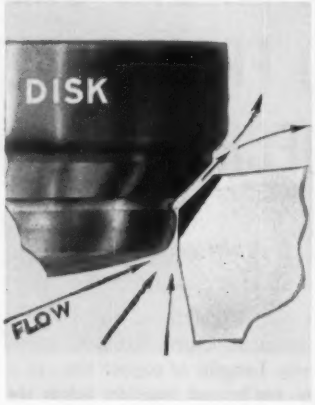


EVALTHRUST* BALL-BEARING CONSTRUCTION

This patented ball-bearing construction is found in all large, high-pressure Edward Valves. Double races on the yoke stem reduce operating torque . . . effectively transmit highest closing torques. An Edward "exclusive."

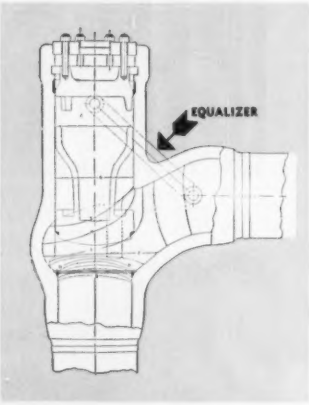
LEAK-PROOF INTEGRAL SEAT

Integral Stellite seat in Edward Valves cuts maintenance, prevents leakage between seat and body. For perfect alignment, applied Stellite is precision-machined in same set-up as body bore, then carefully lapped to form drop-tight mated seating surfaces.



ORIGINAL-DESIGN EDWARD EQUALIZER

For check and non-return valves, the Edward Equalizer connects the high-pressure area above disk-piston with the high-velocity, low-pressure area in the valve outlet. Increases disk lift, cuts pressure drop, reduces disk vibration.



EVALPAK* PREMIUM VALVE PACKING

Edward developed the *first* asbestos-graphite packing with special processing to prevent stem pitting. Die-molded to fit exactly the stem and stuffing box, it is wire-supported and features low operating torque. Durable, easily replaceable.

IMPACTOR* HANDWHEEL

Exclusive Impactor* handwheel multiplies the closing force a man can deliver, assures tight seating with minimum effort in minimum space. Often eliminates need for bulky, expensive gearing or motors.

*Reg. T.M., Edward Valves, Inc.

Rockwell-Built Edward Valves

in STANDARD Steel Valves

valves from Edward, long-time leader in the field

We all know that no one gets "something for nothing." Yet, by careful evaluation and selection, it *is* possible to obtain "special" features in *standard* steel valves. The secret lies in buying "by company" as well as by price. In dealing with Edward, whose products have been the industry's standard of excellence for years, you avail yourself of three important benefits:

1. access to the results of continuing laboratory research on steel valves;

2. expert assistance on valve selection, installation, operation, maintenance and repair;

3. steel valves which are truly superior in design, function and durability . . . but which are not substantially more expensive than ordinary types.

For example . . . a half-dozen "special valve" features —which are *standard* in Edward Valves—are shown in handy clip-out form on the opposite page. ALL of these features are Edward "firsts" . . . MOST are Edward "exclusives" . . . EACH means *extra value* for you!

We invite you to consult your Edward Valve Representative. He is technically trained, thoroughly experienced, eager to help you obtain the *most* value for your valve dollar. At his disposal—and yours—are the results of substantial investment in steel valve research. Let him *use* those results to solve your problems. A card or a call will bring him "on the double" . . . so make it a point to contact us *now!*

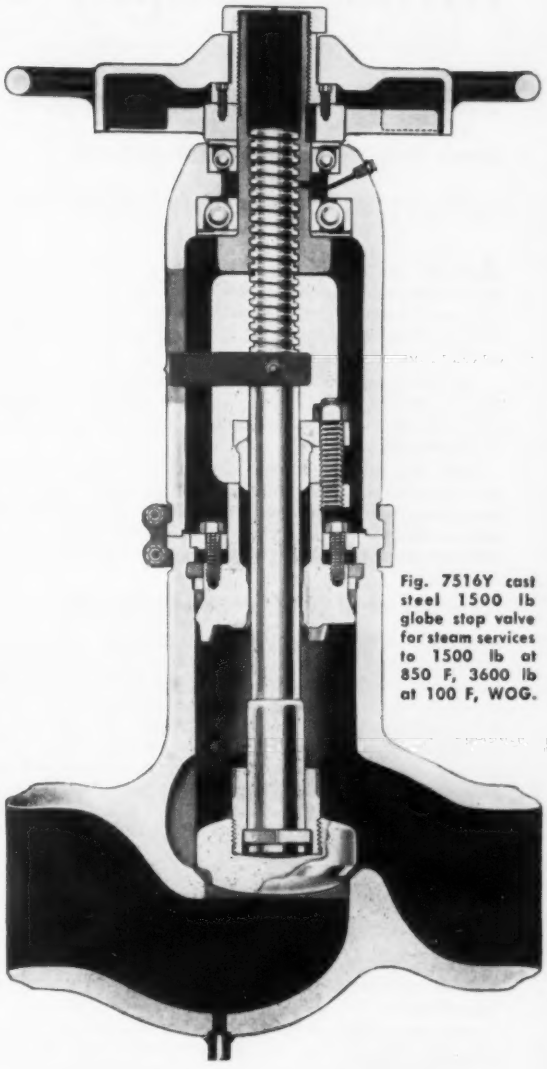


Fig. 7516Y cast steel 1500 lb globe stop valve for steam services to 1500 lb at 850 F, 3600 lb at 100 F, WOG.

Edward builds a complete line of forged and cast steel valves from ⅛" to 16" in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs for pressures up to 7500 lb with pressure-seal, bolted, union or welded bonnets and screwed, welding, or flanged ends.

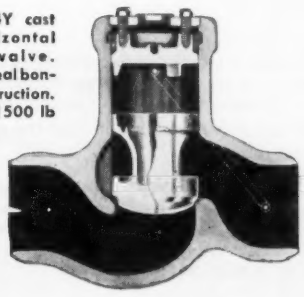


Fig. 7594Y cast steel horizontal check valve. Pressure-seal bonnet construction. Rated at 1500 lb at 850 F.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

1230 West 145th Street, EAST CHICAGO, INDIANA

Kaiser Aluminum sheet for jacketing offers new economies through improved application methods

Recent developments make possible new low costs for the power, refinery and chemical industries

As you can see in the relative cost charts at the right, aluminum sheet jacketing now offers the *lowest first cost* of four well-known finishing methods for pipe insulation . . . and it offers *lower first cost* than wet-construction finishing methods for vessel insulation.

Another important fact, not revealed in the charts, is that aluminum's first cost is becoming *increasingly* competitive, thanks to newly-developed methods that speed application and reduce labor costs!

And if maintenance costs were added to the comparisons, aluminum would present an *even better value*—because only aluminum eliminates maintenance.* Its remarkable resistance to corrosion eliminates the need for painting . . . even when exposed to weather and mechanical abuse.

New Dry Wall Construction for Vessels

A number of improvements in application technique—developed by Kaiser Aluminum engineers in cooperation with specialists from various industries—adapt dry-wall type construction to the finishing of large cylindrical and flat insulated surfaces. These techniques virtually eliminate the need for costly application methods used to apply wet materials such as insulating cements, emulsions, mastics, adhesives, glue sizing and paint. Where corrugated aluminum sheets are used, positioning and fastening are simplified and speeded by familiar techniques employed for block insulations.

New "Snap-Back" Aluminum Jacketing Speeds Installation on Piping

Aluminum's unique advantages in light weight and superior workability have made possible greatly simplified preformed "snap" jackets for quick, easy application on piping.

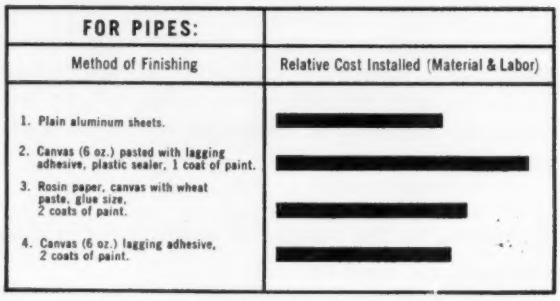
Jacketing, preformed into undersize tubes from stiff sheets of aluminum, will snap back to a tight fit when placed over pipe insulation, freeing both hands for fastening. This tight fit requires less fasteners per running foot.

The following is an outline discussion of important factors in aluminum jacketing materials and alloys, with suggested application methods best suited to various insulated surfaces, including pipes, vessels, vessel heads and others.

The Jacketing Alloys

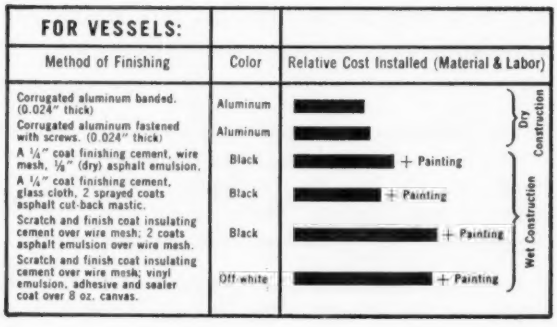
The following aluminum alloys, supplied in flat or coiled sheets, are successfully used for insulation jacketing: 1100, 3003, 3004, 5005, 5050, 5052, Kaiser Aluminum industrial roofing and siding alloy, and Kaiser Aluminum standard roofing alloy.

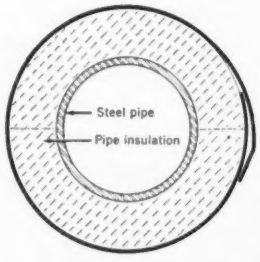
*Roofing felt has a lower initial cost than aluminum, but painting and maintenance offset this initial cost advantage.


FOR PIPES:
Method of Finishing
Relative Cost Installed (Material & Labor)
1. Plain aluminum sheets.
2. Canvas (6 oz.) pasted with lagging adhesive, plastic sealer, 1 coat of paint.
3. Rosin paper, canvas with wheat paste, glue size, 2 coats of paint.
4. Canvas (6 oz.) lagging adhesive, 2 coats of paint.

Results of first cost analyses of various insulation finishes

NOTE: Charts show first costs only. To arrive at total costs, maintenance costs must be added. Whereas other finishing methods require frequent and costly maintenance, aluminum jacketing is virtually maintenance-free.


FOR VESSELS:
Method of Finishing
Color
Relative Cost Installed (Material & Labor)
Corrugated aluminum banded. (0.024" thick)
Aluminum
Corrugated aluminum fastened with screws. (0.024" thick)
Aluminum
Dry Construction
A ¼" coat finishing cement, wire mesh, ⅛" (dry) asphalt emulsion.
Black
+ Painting
A ¼" coat finishing cement, glass cloth, 2 sprayed coats asphalt cut-back mastic.
Black
+ Painting
Scratch and finish coat insulating cement over wire mesh, 2 coats asphalt emulsion over wire mesh.
Black
+ Painting
Scratch and finish coat insulating cement over wire mesh; vinyl emulsion, adhesive and sealer coat over 8 oz. canvas.
Off-white
+ Painting
Wet Construction



Sketch shows how preformed jacketing snaps back over piping, providing quick installation combined with tight fit. This is also demonstrated in photo titled "Teamwork."

Based on maximum economy and performance, the general recommendation is the use of Kaiser Aluminum alloy 5005 and Kaiser Aluminum industrial roofing and siding.

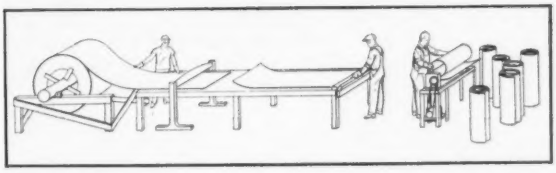
The reasons for this recommendation, and the exceptions to it, are as follows:

(a) Alloys in the 5000 series (which contain magnesium as the principal alloying element) and the clad alloys, such as AlClad 3004 (from which Kaiser Aluminum industrial roofing and siding sheet is made), offer superior corrosion resistance—especially in marine atmospheres.

(b) Alloy 5005 and the industrial roofing and siding alloy provide top performance at lowest cost for most jobs. Alloy 5050 shows an advantage from the standpoint of strength over 5005, and in many instances its slightly increased cost (a fraction of a cent per square foot) is warranted. Where exceptional strength is required, alloy 5052 should be used.

(c) Closely allied with alloy selection is a consideration of the section modulus of jacketing for large diameter vertical vessels. Kaiser Aluminum industrial roofing and siding sheet is superior in section modulus. On certain vertical vessels, usually those in the range of 3′ to 12′ in diameter, some designers prefer the close-up appearance of smaller corrugations. When this is preferred, most of the common alloys and the standard corrugated roofing alloy are satisfactory. Sheets should be 0.024″ thick, embossed, corrugated to 1¼″ x ¼″, and supplied in finished widths of 26″.

A metal thickness of 0.024″ is recommended in most cases. Corrugated aluminum 0.024″ thick can be banded at less material and labor cost than the thinner 0.019″ material fastened with screws. For insulated pipes with an O.D. of 12.75″ and less, 0.020″ thick aluminum sheet is recommended.



These illustrations show method used to fabricate snap jackets:

1. Using aluminum of proper alloy and temper . . .
2. Cutting it to proper dimensions for easy, economical installation . . .
3. Properly stiffening the overlapping edge by a simple angular crimp . . .
4. Forming it through a roller for proper circumference . . .
5. Snapping it around insulated pipe (below).

Teamwork—with one man to snap jackets in place and another to band them, two men can cover 700 feet of 10-inch diameter tubing in one day!

The best temper for pipe jacketing is ¾ hard, designed as H-16 or H-36. For fitting jackets requiring numerous lock seams, ½ hard temper, H-14 or H-34, is recommended.

Pipe Jackets

Snap jackets are a quick, easy and economical method of enclosing insulated pipe. The simple process shown above produces a most effective jacket for pipe insulation. (Kaiser Aluminum's booklet, *"Insulation Jacketing Materials and Methods,"* explains and describes the process in full detail.)

The alloy recommended is 5005-H16, in coiled sheet form with plain finish. Embossed finishes are also available. Other alloys may be used, but it is desirable to use one alloy throughout. Width of coiled sheet should be 36″. Recommended thicknesses of sheets are 0.020″ for insulation O.D. of 12.75″ and under, and 0.024″ for insulation O.D. of 14″ and larger.

Vessel Jackets

Insulated vessels 36″ O.D. and less—horizontal or vertical—should be jacketed with 0.024″ thick by 36″ wide 5005-H16 alloy sheet, plain finish preferred.

For insulated vessels larger than 36″ O.D., horizontal mounting, use the same coiled sheet as above; for vertical mounting, use Kaiser Aluminum industrial roofing and siding, 0.024″ thick, embossed finished, ⅞″ deep corrugations with 2.67″ pitch.

Jackets for Large, Flat Surfaces

For breechings and ducts, indoors and out, Kaiser Aluminum industrial roofing and siding, 0.024″ and 0.032″ thick and having ⅞″ deep by 2.67″ pitch corrugations are most economical. Flat sheet, fluted sheet, and flat sheets stiffened with roll-formed standing seams offer other possibilities.

For insulated boiler walls, jackets may be made of aluminum sheets of several types. Thickness, size and fastening method will vary with specific boiler designs.

Fasteners

For pipes and vessels with insulation O.D. 36″ or smaller, bands may be slit from the same aluminum sheet used for pipe jackets, or they may be purchased as standard stock items. For pipe insulation O.D. 12.75″ and smaller, bands should be ½″ wide by 0.020″ thick, equal to A. J. Gerrard #305-AL; seals should be equal to A. J. Gerrard #202-AL. For pipe or vessels with insulation O.D. 14″ to 36″, bands should be ¾″ wide by 0.020″ thick, equal to A. J. Gerrard #311-AL; seals should be equal to A. J. Gerrard #204-AL. For vessels with insulation O.D. 36″ and larger, ¾″ wide by 0.020″ thick #18-8 stainless steel expansion bands should be used. Banding should be equal to A. J. Gerrard Expand-R-Strap, #E311 ½ S-4; seals should be #18-8 stainless steel, equal to A. J. Gerrard #204-SS.

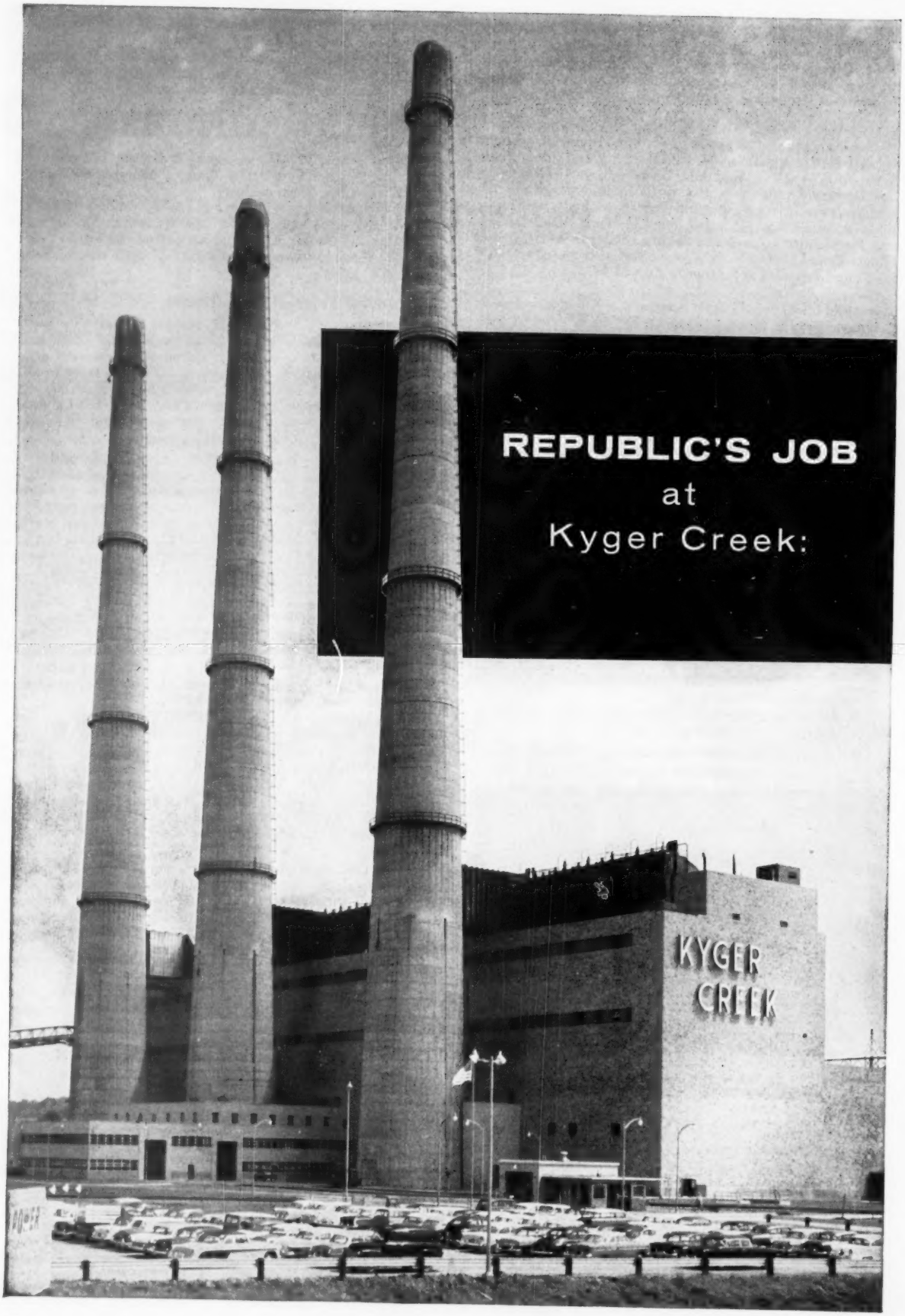
When required for pipe and fitting jackets, #7 by ½″ aluminum pan head self-tapping screws, Type A, are suggested. Side laps and flashing with corrugated vessel jackets should be fastened with #7 x ¾″ aluminum pan head screws, Type A. Aluminum screws should be made from either 6061-T6 alloy or anodized 2024. For fastening aluminum jackets to steel structural members, use #14 hex head screws, Type B, made from stainless steel #18-8 alloy; #410 is acceptable.

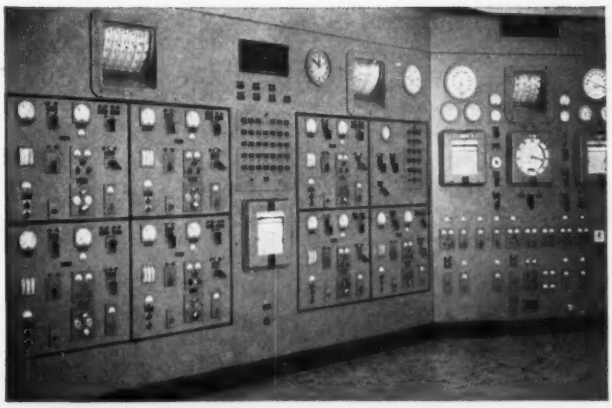
Composite studs made from #18-8 stainless steel and aluminum (equal to Nelson Rivweld Studs or to Nelson Set Lock Studs supplied with aluminum washers) may be used to fasten corrugated aluminum jackets to angles. On siding, fasten studs on low part of corrugation. On roofing, fasten studs on crown of corrugation.

Aluminum Jacketing Booklet Available

Kaiser Aluminum's new booklet, *"Insulation Jacketing Materials and Methods,"* gives you complete details on the subjects outlined above. It also presents illustrated step by step application methods plus material and accessories charts to help you take advantage of recent advances in aluminum sheet jacketing. Forty fully illustrated pages in all! To get your free copy, write to: *Kaiser Aluminum & Chemical Sales, Inc., Process Industries Department, 919 N. Michigan Ave., Chicago 11, Illinois.*

KAISER Aluminum


REPUBLIC'S JOB
at
Kyger Creek:
KYGER
CREEK



One of the five control centers where an "Electronic Master" automatically integrates data and master-loads pneumatic power operators throughout the unit. Manual operation of any function can be taken over by the man on duty at a moment's notice.

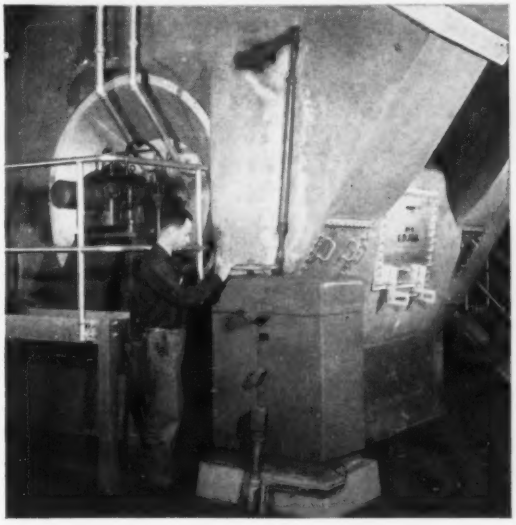
Primary air and coal to each pulverizer (7 per boiler) is pneumatically adjusted to each load by the "Electronic Master," which always holds the desired fuel/air ratio. Electronic loadings can be remotely adjusted to regulate the portion of total fuel fired by each pulverizer. An electronic fuel splitter and fuel totalizer automatically divide the coal in the desired ratios among all pulverizers in operation, permitting the addition or removal of pulverizers from the line with minimum disturbances.

control five 1,400,000 lb./hr. boilers —automatically

Kyger Creek Power Plant of the Ohio Valley Electric Corp. produces a million kilowatts for our national atomic program — which makes it one of the most critical power plants in the world.

To keep each of the five huge boilers at top efficiency at all loads, it is necessary to regulate 7 coal pulverizers, 14 burners, 2 F.D. fans, 2 I.D. fans, and many shut-off and regulating dampers as if they were a single unit. The Republic *load* sensing combustion control with the "Electronic Master" keeps tabs on all these inter-related functions. This system makes sure that every change in steam flow is countered with the corrected fuel, air and draft settings *before the load change produces a change in steam pressure.* A follow-up *pressure* control system makes final corrections in control signals (if needed) to hold pressure fluctuations near zero.

Kyger Creek Plant is unusually efficient (7 lb. steam per kwhr) and is one of the country's largest steam plants, but the Kyger Creek combustion control problems are the same ones encountered in any plant striving for stability and peak efficiency. Republic's experience with plants of all sizes, all pressure and temperature ranges, and all load characteristics is your best guarantee of getting all the premium performance built into your major equipment. Never assume any proposal is *best* until you have checked with Republic engineers; they can save you operating, performance and maintenance problems for the full life of your plant.



To permit furnace pressure regulation without upsetting combustion air supply, I.D. fans (above) are interlocked with the F.D. fans through the furnace pressure and air flow regulators. I.D. fans are needed only 5% of the time. All fans are constant speed with inlet vane controls, and can be isolated by means of remotely-operated shutoff dampers.

REPUBLIC FLOW METERS CO.

A Subsidiary of Rockwell Manufacturing Company

2240 Diversey Parkway • Chicago 47, Illinois

Chicago's newest is served

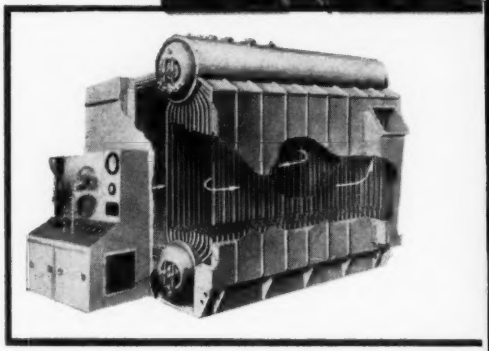
Located on a 100 acre site overlooking Lake Michigan, Chicago's newest planned community, the Lake Meadows project, offers gracious living within the confines of a large city. Owned and managed by the New York Life Insurance Company, Lake Meadows provides distinctively appointed apartments, spacious grounds, a modern shopping center, ample parking facilities, yet is within minutes of the heart of the city. When completed, this project will house 2000 families and will include an eight acre park. In addition, construction has already begun on a new elementary school located on a two acre plot adjacent to the housing development.

A project of this size requires considerable steam capacity to provide ample heat and hot water and to perform the many other services required. To do the job, the New York Life Insurance Company originally selected 3 C-E Package Boilers, Type VP. Later, as new housing units were added, 2 additional VP Boilers were installed. Their outstanding performance and efficient, trouble-free operation is evidenced by the repeat order placed with Combustion for the final 2 units.

VP Boiler Catalogs are available on request.

VP ADVANTAGES

VP Boilers are completely shop-assembled . . . available in fourteen sizes from 4,000 to 50,000 lb steam per hr . . . for pressures up to 500 psi . . . for oil or gas firing. They have more water-cooled area per cubic foot of furnace volume . . . a 30-inch diameter lower drum which gives more water storage capacity and easy access . . . quiet, low-speed centrifugal fan. They require only a simple concrete slab foundation.



COMBUSTION

Combustion Engineering Building

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS.

planned community
by C-E Boilers

Architect's rendering of the Lake Meadows project. Skidmore, Owings and Merrill, Architects.

AT FAR LEFT – Cutaway view of typical VP Boiler. This model has integral console control panel.

AT LEFT – Firing aisle of the Lake Meadows boiler room showing three of the five C-E Package Boilers, Type VP.

ENGINEERING

200 Madison Avenue, New York 16, N. Y.

C-E

B-986C

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

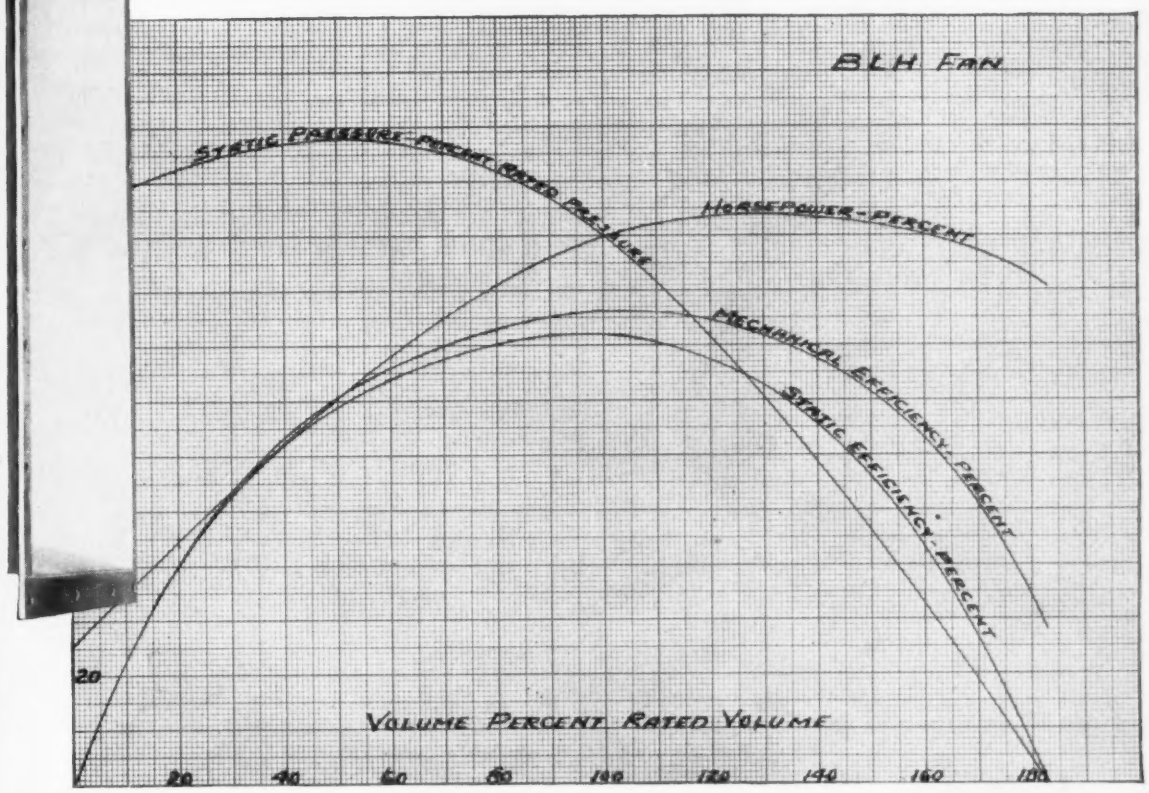
A NEW HIGH IN

"Buffalo" Type BLH Fan for high pressure air moving. Its efficiency is due to advanced rotor, inlet and outlet features developed exclusively by "Buffalo".

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT

FORCED DRAFT EFFICIENCY OVER THIS BROAD RANGE!

"BUFFALO" TYPE BLH FAN FOR CLASSES II, III AND IV



If peak efficiency, along with durability and servicability, are important to you in a forced draft fan, the BLH deserves your closest investigation.

Note the broad curve of mechanical efficiency above — 80% or better from 65% to 135% of rated volume — permitting flexibility of operation. This performance has been achieved through inlet-to-outlet streamlining — a smooth inlet bell, cantilevered inlet vanes, backward curve blades, specially curved rotor flange and divergent outlet — minimizing turbulence at every point to give air the smoothest ride ever. And the new "Buffalo" Variable Inlet Vanes can be substituted for the stationary inlet vanes for smooth draft control with no performance loss in open position.

The BLH is one of a complete *series* of "Buffalo" Draft Fans available to meet your draft requirements exactly, with no guess work and no compromise. Write for Bulletin F-200 and recommendations on your problem.

"Buffalo" Cantilevered Variable Inlet Vanes have no center ring to cause entry loss, and the control mechanism is out of the air stream, assuring smooth volume control without sacrificing fan performance.

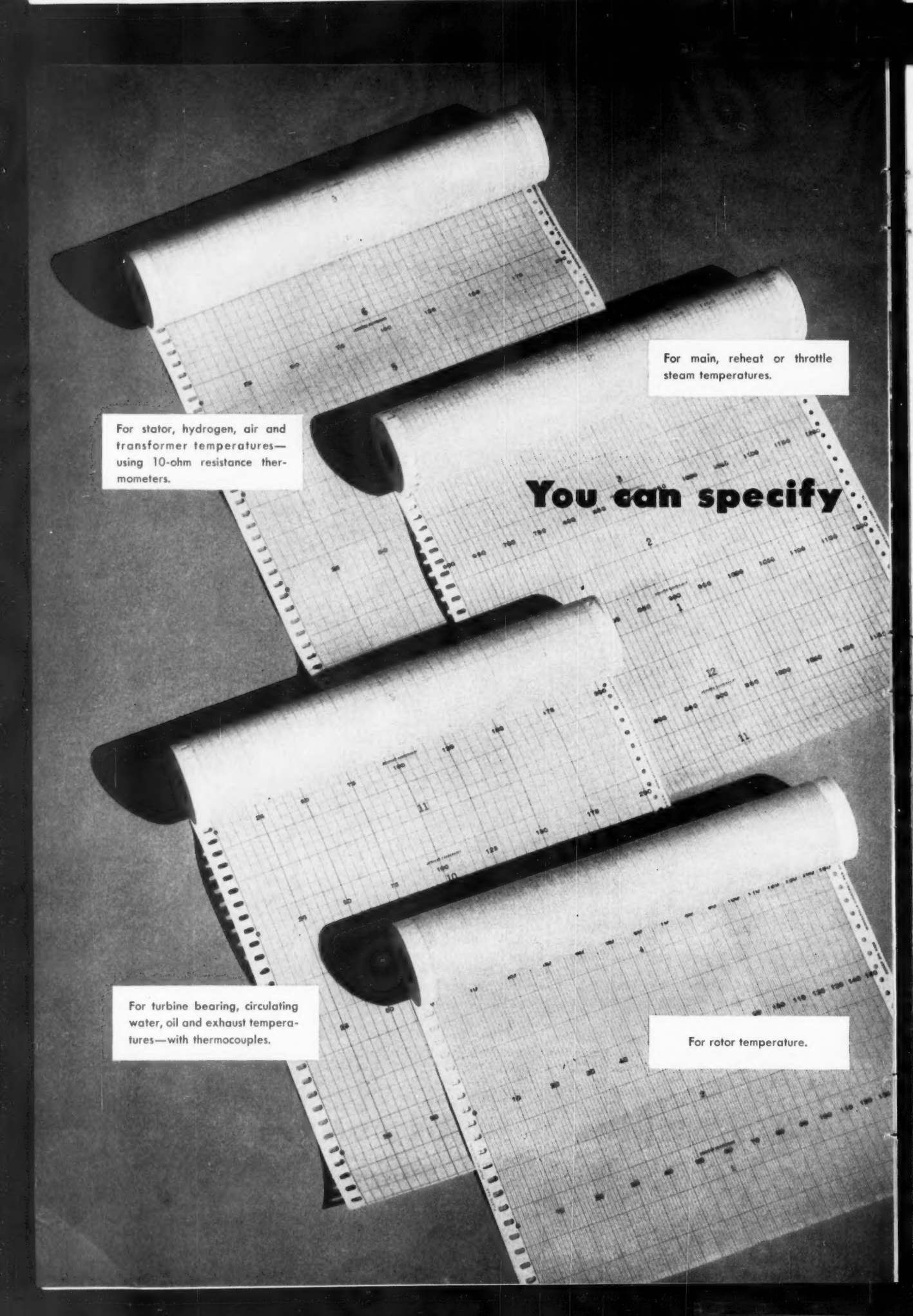
"Buffalo"

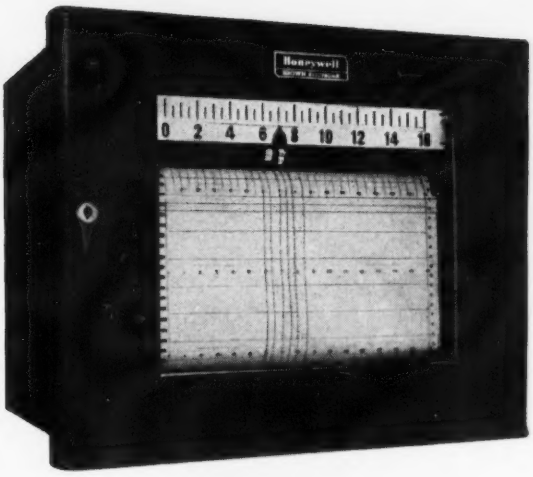
BUFFALO FORGE COMPANY

BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING


You can specify
For stator, hydrogen, air and transformer temperatures—using 10-ohm resistance thermometers.
For main, reheat or throttle steam temperatures.
For turbine bearing, circulating water, oil and exhaust temperatures—with thermocouples.
For rotor temperature.



ElectroniK strip chart recorders can be supplied for power plant use with scores of different temperature calibrations. Some of the typical standard charts are shown on the opposite page. Actual chart size is 11 inches in calibrated width.

an *ElectroniK* recorder ... for any of your temperature measurements

LET *ElectroniK* recorders keep constant watch over your plant temperatures—accurately, efficiently.

Choose one *ElectroniK* instrument to record a single temperature, or another to combine as many as twenty temperature records on a single chart. When several temperatures are combined on one chart, correlation is simple . . . operators can keep close check on trends . . . engineers can analyze operation in accurate detail.

Built-in circuits adapt these recorders for signalling excess temperatures. And there's a complete Honeywell line of thermocouples, extension wires, and power-plant-type resistance thermometers to work with *ElectroniK* instruments.

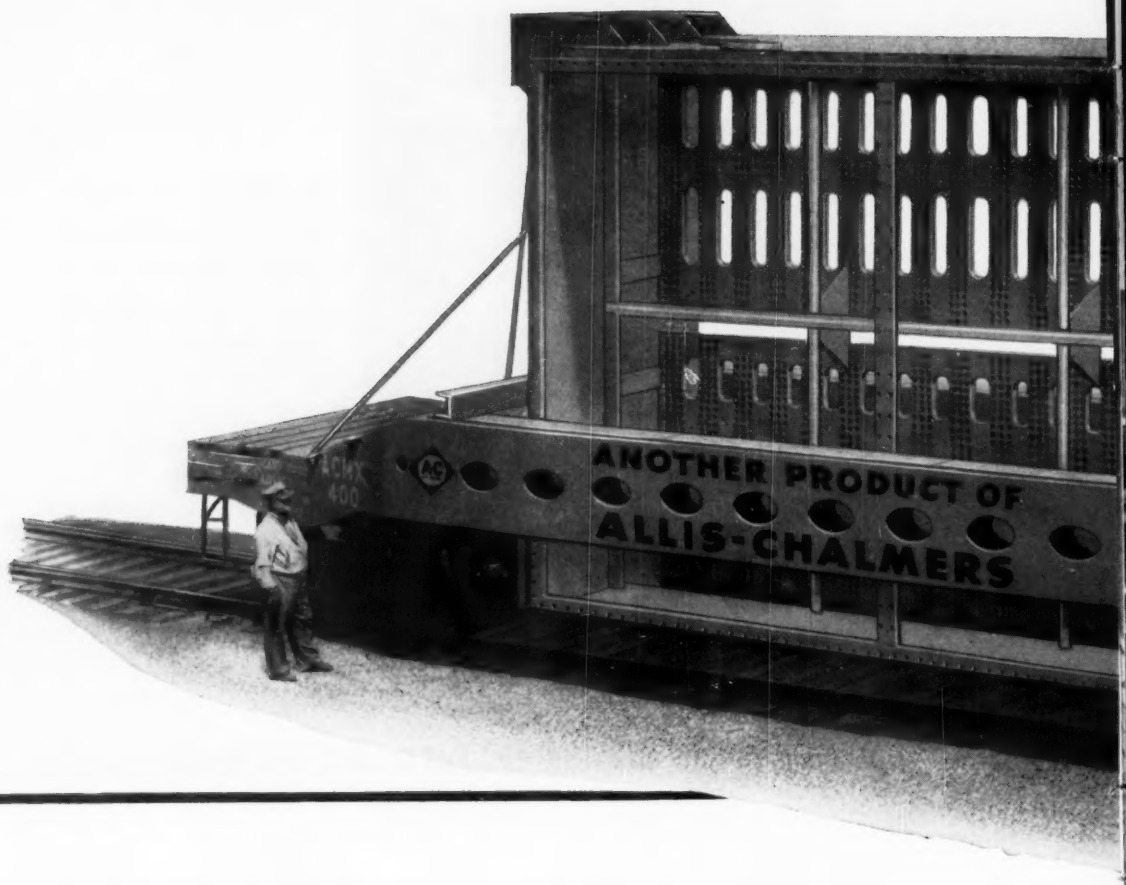
ElectroniK instruments are famous for their stamina and dependability. For a discussion of how they can be applied to measuring your plant temperatures, call your local Honeywell field engineer. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for Bulletin 9070, "Instruments for Electrical Power Generation."

Honeywell

First in Controls



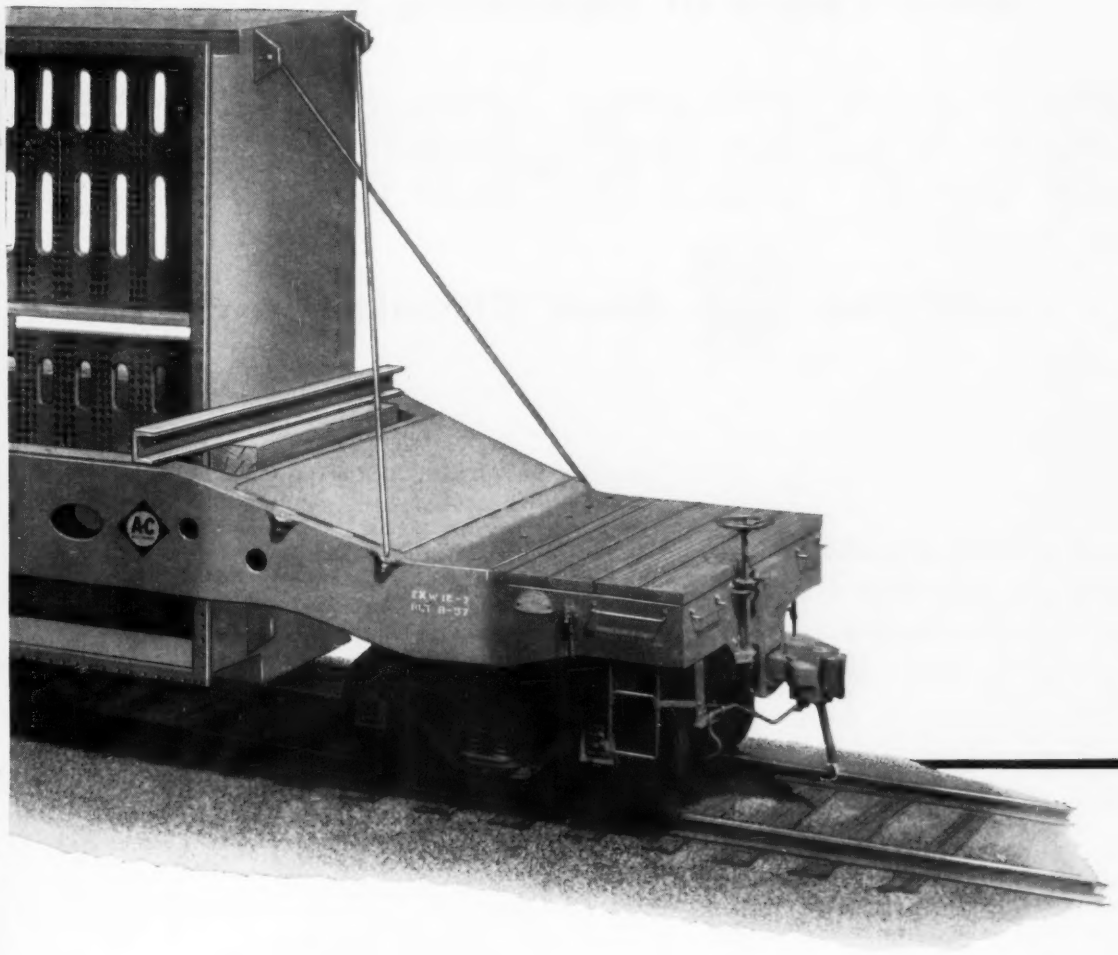
Now in Service!

New well-center cars reduce condenser erection time and costs

For details, call your nearby A-C representative or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin

A-C ALLIS-CHALMERS

A-5453



These new Allis-Chalmers cars, specially built to A-C design, carry loads of greater dimension than any conventional car can handle . . . permit shipment of larger shell sections, cut erection time at the job-site.

With an overall width of 12 feet 7 inches, these cars take shell sections up to 30 feet long, 10 feet wide, 18 feet high. Cars used previously could take sections only 7½ feet wide.

This solution to the problem of transporting continually larger condensers to ever larger power plants is an example of the attention given to *all* the problems involved in building condensers — research, engineering, manufacturing, shipping, erecting, servicing. When you specify Allis-Chalmers you get complete engineering for optimum efficiency.

Matched Auxiliaries

Whatever your requirements may be in size or shape, Allis-Chalmers can supply surface condensers and all necessary auxiliaries — circulating pumps, condensate pumps, motors, air ejectors, controls, valves — all engineered by Allis-Chalmers.

ALLIS-CHALMERS

Nine Years of Operating Experience

SUPER-PURE

with the FW Dual Circulation Boiler

Low carryover of silica and solids, at design pressures up to 2200 psi, with low-purity feedwater and make-up as high as 100%, proves soundness of dual circulation design

EXPERIENCE with the FW dual circulation steam generator — now in the tenth year of successful operation — clearly demonstrates its effectiveness in producing high purity steam from waters which had previously been considered unsatisfactory for high-pressure boiler make-up. The following advantages have now been fully realized in installations with design pressures up to 2200 psi, and make-up as high as 100%.

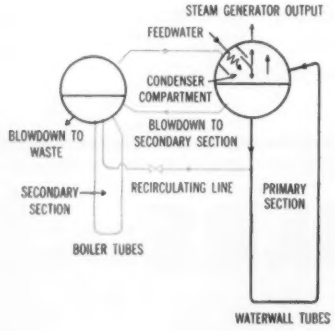
Sharply reduced carryover of silica and solids, preventing costly fouling of turbine blades.

Low concentration in high-duty furnace section, resulting in minimum tube damage and reduced boiler maintenance.

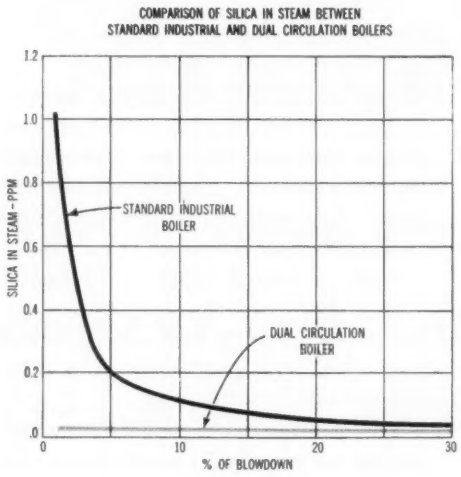
Reduced blowdown with lower heat loss and smaller heat recovery equipment.

Reduced feedwater purity requirements, permitting less expensive water treatment even with high make-up.

The dual circulation boiler utilizes *two* separate heat absorbing sections — a radiant *primary* section (where most of the steam is generated), and a low-heat-absorption *secondary* section (convection portion of boiler). Blowdown from the primary, usually at a high rate, provides feed for the secondary section. This reduces concentration in the primary section to a much lower value than in the secondary section. Steam generated in the secondary section is returned to the primary drum where it is scrubbed by feedwater and condensed in whole or in part before mixing with the primary steam. Even with high concentrations in the secondary, low steam release rates prevent excessive moisture carryover from this section. The effectiveness of this design in reducing carryover of silica to the turbine is well illustrated by the comparative test data plotted below for the conditions indicated. For further details on FW Dual Circulation Steam Generators, send for a copy of Bulletin B-50-11. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*



Simplified flow diagram showing principle of Dual Circulation. Secondary section and blowdown to secondary section are shown in color.



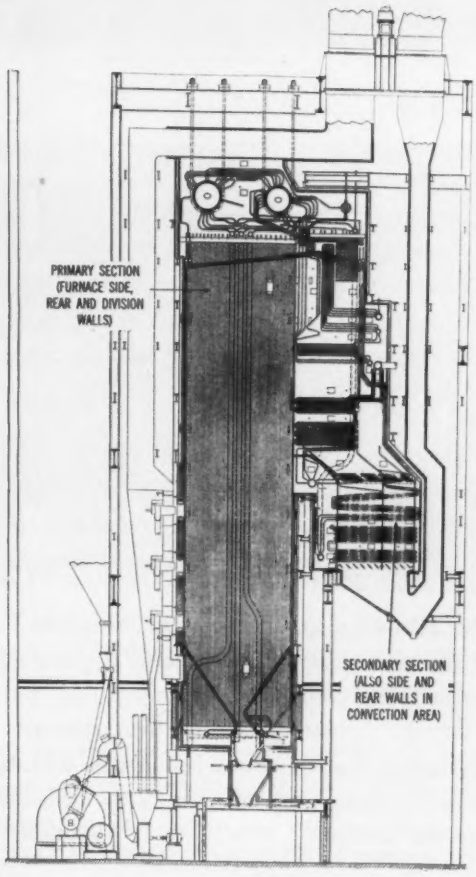
Drum Operating Pressure — Approx. 1500 psi.
Total Soluble Solids in Feedwater — 150 ppm
Silica (SiO_2) in Feedwater — 1 ppm
Evaporation in Secondary Sec. — 33% of total boiler output

FOSTER

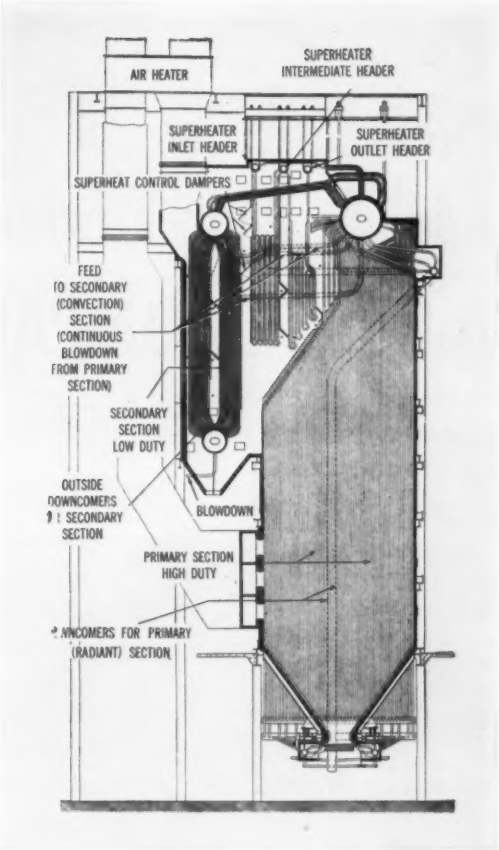
NEW YORK • LONDON

in Generating

STEAM

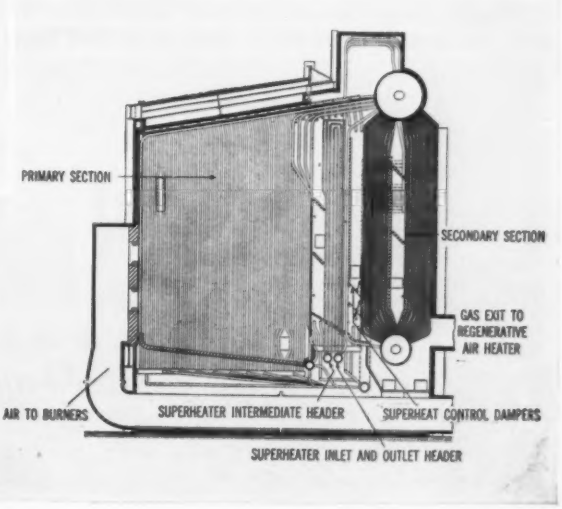


▲ Cross section of Dual Circulation reheat steam generator designed for a maximum continuous output of 1,450,000 lb/hr with a design pressure of 2075 psig, normally operating with low make-up. Steam temperature of 1000F is maintained over a load range from 500,000 lb/hr to maximum rating. The primary section consists of waterwall surface exposed to radiation from the flame and gases while the secondary consists of extended surface heated by convection.



▲ Cross section of a three-drum Dual Circulation Steam Generator designed for 300,000 lb/hr, 1500 psi, 900F, with 100% make-up. Steam-water mixture leaving wall tubes passes through washing and separating compartments in the primary drum. Water from the high-duty section is continuously blown down to the low-heat-absorption secondary section, shown in color. Steam from the secondary is returned to the primary and condensed by incoming feedwater.

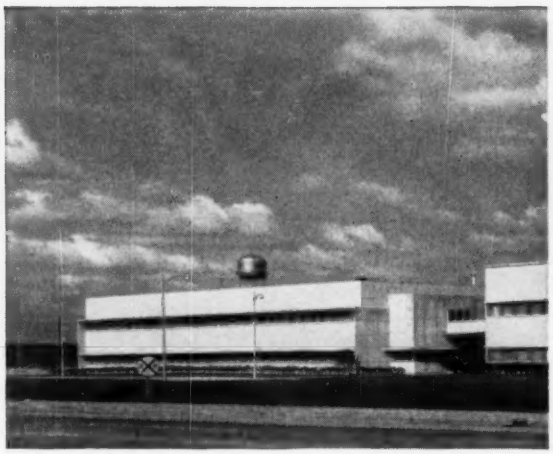
Cross section of a two-drum Dual Circulation Steam Generator designed for 300,000 lb/hr, 700 psi, 750F, with high make-up. Here the primary and secondary sections are segregated within the single upper drum. The waterwall tubes comprise the high-heat-absorption primary section and the boiler bank or convection section comprises the low-heat-absorption secondary section. ▼



WHEELER

PARIS • ST. CATHARINES, ONT.

Pneumatic Control System Adds to Plant Efficiency at A·B·DICK COMPANY...



Accurate control of temperatures and humidities is required throughout the 715,000 sq. ft. plant of A. B. Dick Company, the nation's largest exclusive maker of duplicating equipment and supplies. The multi-building plant has a wide variety of control needs, all of which are met by a specially engineered Johnson Pneumatic Control System.

In the air conditioned web process section, for example, stencils wrinkle if humidity is too high, won't coat properly if too low. Extremes of heat, cold and humidity as well as constant temperature and humidity conditions are produced in connection with the company's extensive research and testing programs. In the general manufacturing and assembly area, the system operates 47 ceiling-mounted heating and ventilating units. The explosion-proof features of pneumatic control are essential in areas where ether, alcohol and other hazardous materials are used. And, of course, there's the provision of air conditioned comfort for the administrative, sales and technical staffs.

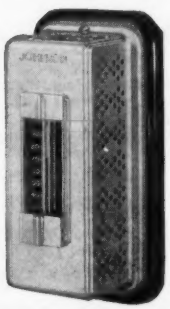
This close control of temperatures and humidities simplifies A. B. Dick Company's material handling and processing problems, helps assure high speed, quality production and improves worker efficiency.

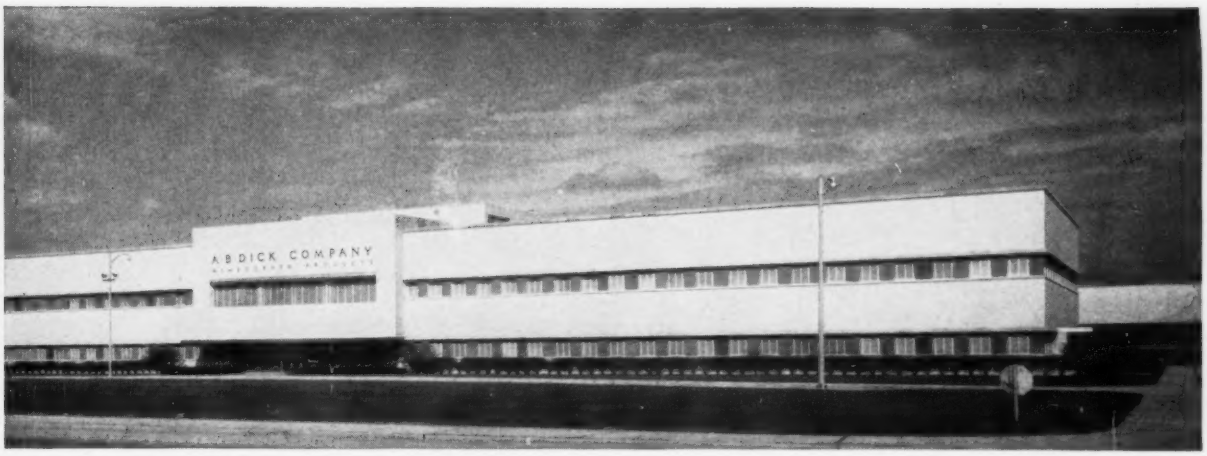
Let Johnson help you enjoy similar benefits. Johnson Pneumatic Control Systems offer a combination of advantages unmatched by any other method of control... widest flexibility, high accuracy, fewer components and easier, less costly operation. A nearby Johnson engineer has all the facts. Johnson Service Company, Milwaukee 1, Wisconsin.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885





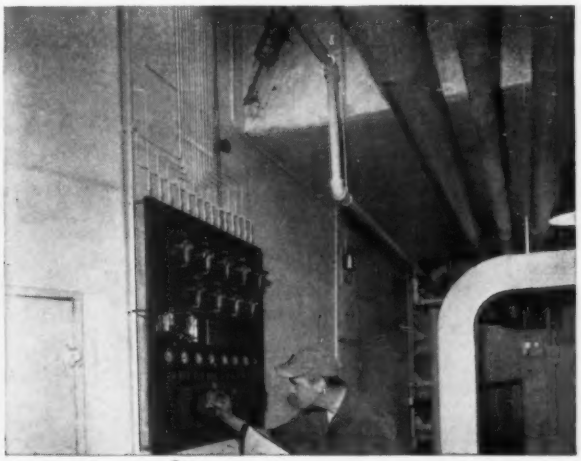
A. B. Dick Company, Chicago. Main Office and Plant designed and built by The Austin Company. For the West Office Building, Ragnar Benson, Inc., Chicago, engineers and builders, and Robert E. Hattis, Chicago, consulting engineer.

In the main test section, A. B. Dick products are subjected to continuous, exhaustive tests. The Johnson System maintains a constant condition of 72 F and 50 per cent relative humidity. In the isolated dry room, left, and hot-humid room, right, special tests are conducted under extremely adverse conditions. In this section, temperature variations are limited to ± ½ F and humidity to ± 2 per cent.

Equally close control is maintained in the chemical research laboratory where chemists and technicians work to develop new and better inks and paper coatings for use with A. B. Dick duplicating equipment. Comfortably air conditioned buildings such as this are a big asset in attracting high grade personnel and reducing employee turnover rates.

As with every progressive manufacturer, the development of new products never ceases. Below is a section of the A. B. Dick Company model shop in which new products are hand-made for testing under varied operational conditions. Here, as in many other areas of the building, there is complete year 'round air conditioned comfort.

Behind the scenes, Johnson controllers operate the central fan systems serving the many air conditioned zones of the building. Process hot water, perimeter radiation, process refrigeration and process condensing water are also Johnson controlled. Pressure gauges, exclusive with pneumatic systems, simplify operation.



Westinghouse Preventive Maintenance at Alabama Power Company

FROM COIL ORDER TO COMPLETED REWIND IN 4 WEEKS

This rewound generator, back in service at the Gadsden Steam Plant, is another reason why Alabama Power has long recognized the value of their Preventive Maintenance program.

Westinghouse Preventive Maintenance Inspection Service serves Alabama Power Company, again. When Westinghouse field engineers inspected this 60,000-kw generator in February, 1957, during scheduled overhaul of the generating unit, they found conditions which led to a decision to rewind it during the outage then in progress. Westinghouse was ready with men and materials to do the job.

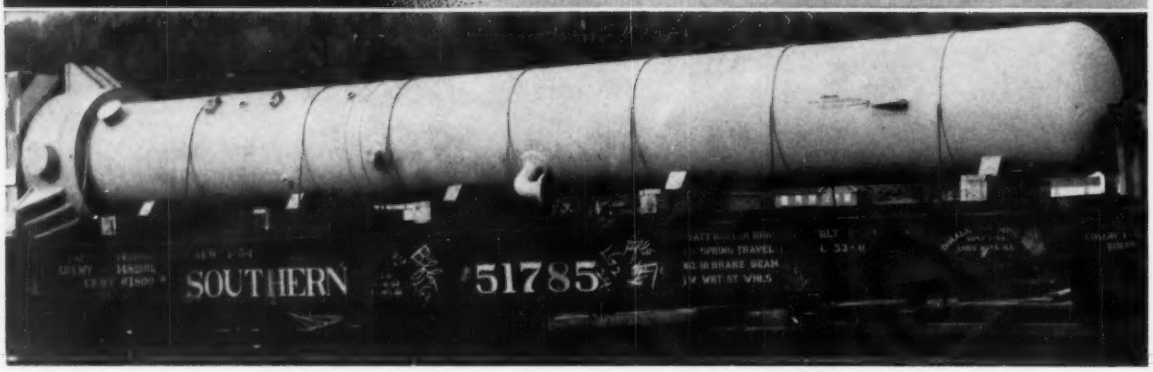
Alabama Power stated the unit couldn't be out of service for more than 5 weeks, or they would suffer additional loss. Westinghouse alerted its personnel, ordered the coils and started working 20 hours a day, 6 days a week, to strip and rewind. The job was completed March 14th, 28 days after the customer order was given.

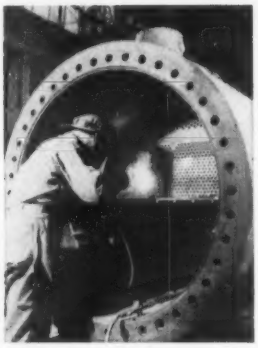
Skilled, highly trained Westinghouse field personnel will perform preventive maintenance inspection, on-the-spot repairs and modernization to keep your electric apparatus operating at peak efficiency. Nationwide, they are on call 24 hours a day with fast, reliable service.

Contact your Westinghouse salesman, or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa. J-95183

YOU CAN BE SURE...IF IT'S Westinghouse

PROGRESS IN POWER through PROGRESS IN HEAT TRANSFER EQUIPMENT





Workman welding copper-nickel tubes to foot-thick steel tube sheet with 140-monel electrodes. Under destructive testing, rolled joints and tubes welded with cupro nickel rods leaked at elevated pressures, but tubes welded with 140-monel electrodes were leak-proof at 9600 psi.

End view showing torus ring welded to channel and channel cover. Access to head is obtained by cutting ring with special tool; torus ring can be re-used. Conventional split key ring assembly taking the load on the cover is retained.

FIRST ALL-WELDED FEEDWATER HEATERS

▶ A few years ago, an all-welded feedwater heater for 3600 psi and 790F would have been called a fantastic dream.

Yet six all-welded feedwater heaters in this pressure-temperature range are now proving their worth in the Linden, N. J., Generating Station of the Public Service Electric and Gas Company. Designed and manufactured by the Yuba Heat Transfer Division, formerly the Heat Exchanger Division of The Lummus Co., these heaters represent one of the many "firsts" contributed by this organization to the progress of the power industry.

In the heater shown above, two 50-inch-diameter cylinder sections of 1⅛-inch carbon steel were welded together. The open ends of the U-bends are welded, not roller-expanded, into the tube sheet (see upper small photo). Heads are sealed by a steel torus ring welded to channel cover and channel (see lower small photo).

The all-welded design minimizes the leakage which occurs in the conventional bolted and gasketed construction under high temperatures and pressures. Results are reduced maintenance and downtime.

This all-welded construction has been so successful it is certain to be specified for practically all future installations. Yuba engineers would be pleased to work with you. Call on them.

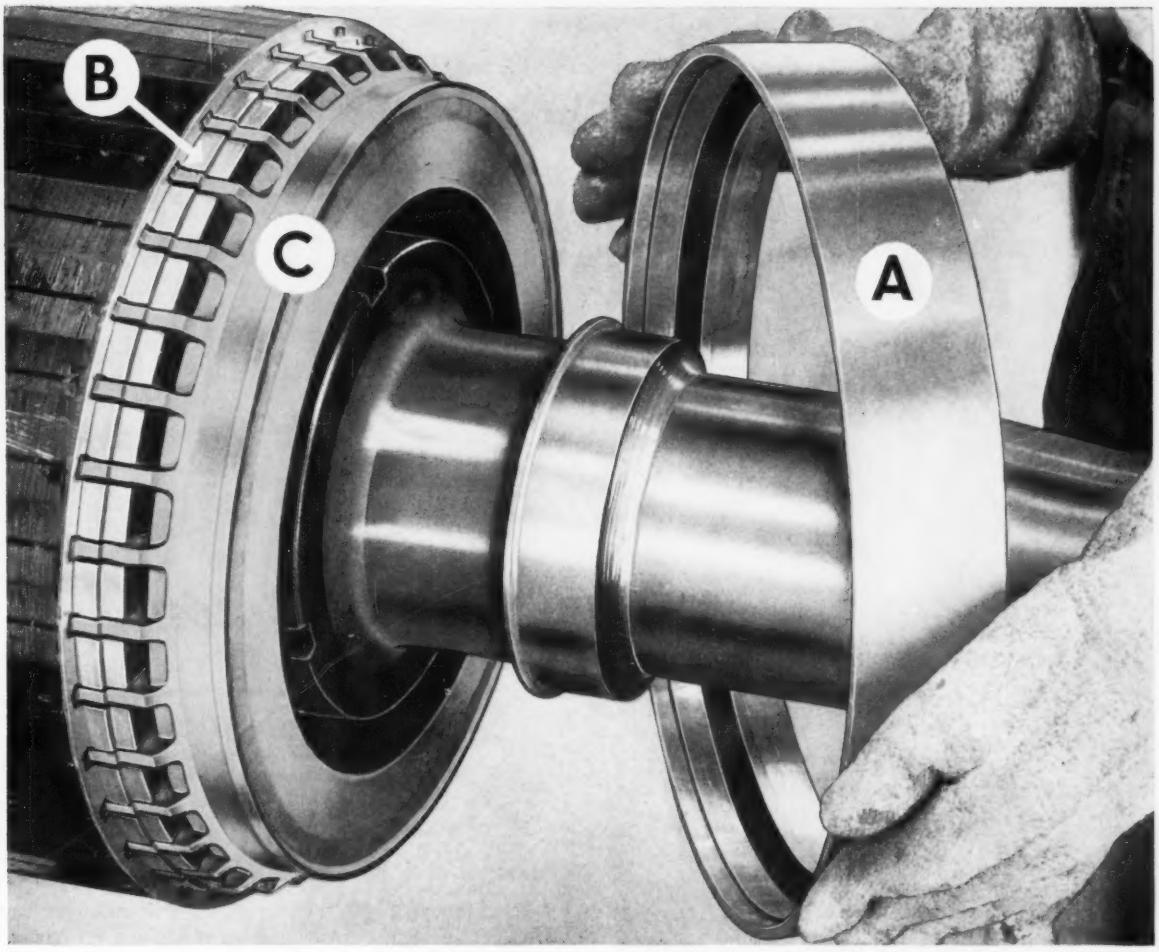
YUBA

CONSOLIDATED INDUSTRIES, INC.

Other Divisions Manufacturing Heat Transfer Equipment
California Steel Products Division, Richmond, Cal.
Adsco Division, Buffalo, N. Y.

YUBA HEAT TRANSFER DIVISION
HONESDALE, PENNSYLVANIA
NEW YORK SALES OFFICE: 530 FIFTH AVENUE
REPRESENTATIVES IN PRINCIPAL CITIES

STEAM SURFACE CONDENSERS • EVAPORATORS
STEAM JET REFRIGERATION • STEAM JET AIR EJECTORS
FEEDWATER HEATERS • BAROMETRIC CONDENSERS



Retainer ring construction is used in E-M Induction Motors rated 900 hp and larger at 3600 rpm, and 1750 hp and larger at 1800 rpm. It's just one of many special features built into every large, E-M Induction Motor.

"Ring around the end ring" locks

Rotational Stability...

into BF pump motors

"I'm Ev Jernberg, Chief Mechanical Engineer at E-M. Over the years we've learned a good deal about building big induction motors. One problem was to retain rotational stability on high-speed applications.

"At E-M we 'lock' precise factory balance into our rotors by shrinking accurately machined, non-magnetic alloy retaining rings around the cage end rings. This supports the 'floating' end rings against centrifugal force and anchors them to the shaft. The retainer (A) is shrunk onto the shaft-connected, rotor endplate (B) and locks the 'floating' end ring (C) perfectly concentric to the shaft. The possibility of unbalance from centrifugal and thermal distortion of the cage winding is thus permanently eliminated."

For further information about E-M Motors, call your nearby E-M Sales Engineer and write for brochure PRD-214.

E-M

1300-TPA-2194

ELECTRIC MACHINERY MFG. COMPANY

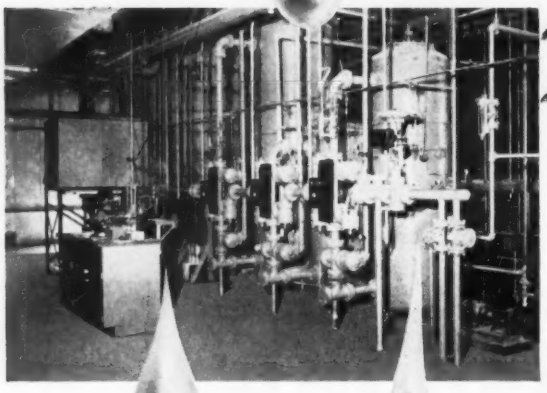
Minneapolis 13, Minnesota

Specialists in making motors do **EXACTLY WHAT YOU WANT THEM TO**

INFILCO

DEMINERALIZATION EQUIPMENT

.....engineered to meet your requirements



MAXIMUM RELIABILITY

HIGHEST QUALITY WATER

Check some of these installations. They are representative of INFILCO's advanced engineering and development in providing water suitable for modern industrial process and power requirements.

Crystal Ice and Cold Storage Company... Phoenix, Ariz.
International Paper Company... Panama City, Fla.
Helene Curtis Industries... Chicago, Ill.
Western Electric Company... Chicago, Ill.
National Petro-Chemicals Corp.... Tuscola, Ill.
Hytron Radio & Electronics Company... Newburyport, Mass.
Raytheon Manufacturing Company... Quincy, Mass.
Hytron Radio & Electronics Company... Kalamazoo, Mich.
Minnesota & Ontario Paper Company... Internat'l Falls, Minn.
Great Northern Oil Company... Roseport, Minn.
International Paper Company... Natchez, Miss.
General Tire & Rubber Company... Ashtabula, Ohio
Turnsted Division, General Motors Corp.... Columbus, Ohio
Security Engineering Div. Dresser Industries... Dallas, Texas

It will pay you to investigate. Write today for Bulletin 1960-C. Inquiries are invited on all water and waste treatment problems, including boiler feed water makeup, process water clarification and purification, waste pollution control, material reclamation and related needs.

INFILCO

INCORPORATED

General Offices • Tucson, Arizona • P.O. Box 5033

Field offices throughout the United States and in foreign countries

INFILCO

THE ONLY COMPANY impartially offering equipment for ALL types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment. 5740-12

Gerry Oscarson, Chief E-M Application Engineer, points out to Ev Jernberg, Chief E-M Mechanical Engineer, the excellent on-the-job dependability record of three, 1500 hp, 3600 rpm E-M Induction Motors driving BF pumps at a big, upper midwest power plant.

These motors show that E-M locked-in

Rotational Stability...

keeps BF pumps running smoothly

"You know, Ev, these three E-M Induction Motors have been on duty here for 24 hours a day for the past four years. The extra pains we take at the factory to make sure our motors keep their perfect balance looks like it's paying off in smooth service and low maintenance."

"That's right, Gerry. Our method of securing the cage end rings with shrunk-on, high strength alloy retaining rings has certainly worked well. Even heavy centrifugal and thermal stresses can't damage these cages. The specially designed retaining ring gives our customers the dependability they need in high speed auxiliary drives."

You, too, can benefit from the special attention E-M gives to rotational stability. Write the factory for Induction Motor brochure PRD-214, and call your nearby E-M Field Engineer for firsthand information about dependable Induction Motors.

E-M

1300-TPA-2198

ELECTRIC MACHINERY MFG. COMPANY

Minneapolis 13, Minnesota

Specialists in making motors do

EXACTLY WHAT YOU WANT THEM TO

G-E looks

at coal as low-cost fuel

For low-cost steam generation and supply availability, GE burns coal in Louisville

General Electric's Major Appliance Division in Louisville, Ky., has six product manufacturing buildings, a warehouse and service buildings—5 million sq. ft. under roof. To generate all steam necessary for process work and heating requirements of this vast area, GE's power plant burns coal the modern way. Coal was chosen for availability and economy. A careful fuel cost study disclosed that, in the Louisville area, coal would give GE the lowest-cost steam generation of all fuels. In addition, full mechanization of GE's power plant has facilitated all details of coal handling and ash removal while completely overcoming the problem of air pollution.

Facts you should know about coal

Not only is bituminous coal the lowest-cost fuel in most industrial areas, but up-to-date coal burning equipment can give you 10% to 40% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at a stable price.

Technical advisory service

The Bituminous Coal Institute offers a free technical advisory service on industrial fuel problems. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send for our case history booklet, complete with data sheets. You'll find it informative.

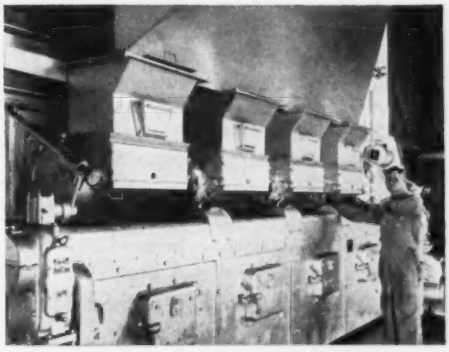
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

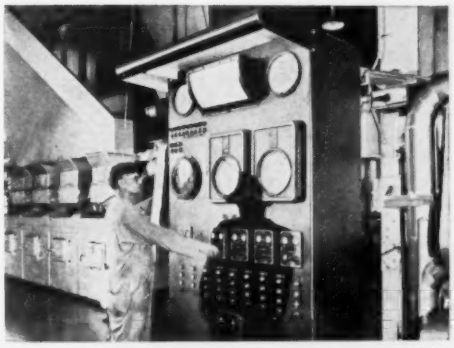
BITUMINOUS COAL INSTITUTE

Southern Building • Washington 5, D.C.

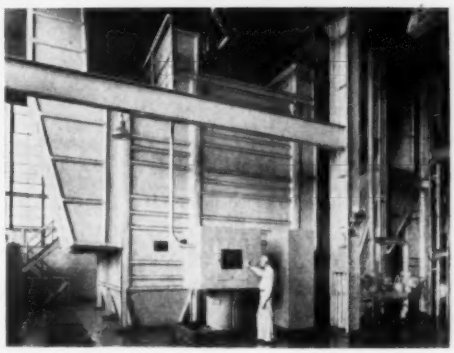
Note cleanliness of firing aisle of GE's power plant. Steam generating equipment consists of five 150,000 lbs./hr. boilers—three by Henry Vogt Machine Co. and two by Riley Stoker Corp.



Close-up of Detroit Rotograte Spreader Stoker on a Henry Vogt boiler. Riley boilers are fired by Riley Spreader Stokers. These stokers operate automatically, with continuous ash discharge. All boilers are equipped with non-segregating chutes.



Control panel for Boiler #5. These are Bailey Meter controls, air-operated, automatically handling coal feed, induced and forced draft, overfire air and feedwater regulation.



Prat-Daniel Electrostatic Precipitator and controls; at right, mechanical precipitator by American Air Filter Co. These are connected in series for automatic, efficient fly ash collection and disposal.

Allis-Chalmers announces... **Newly**

1

Gang-operated disconnect switch isolates starter from incoming power — assures safe entry of high voltage compartments.

2

Steel cubicle is compartmentalized — separates high and low voltage equipment.

3

Short-circuit protection is provided by fast-acting current-limiting fuses, rated 150,000 kva at 2300 volts and 250,000 kva at 4160 or 4600 volts.

4

Overload protection is handled by accurate relays which trip only on excessive motor current, preventing needless motor stoppages.

5

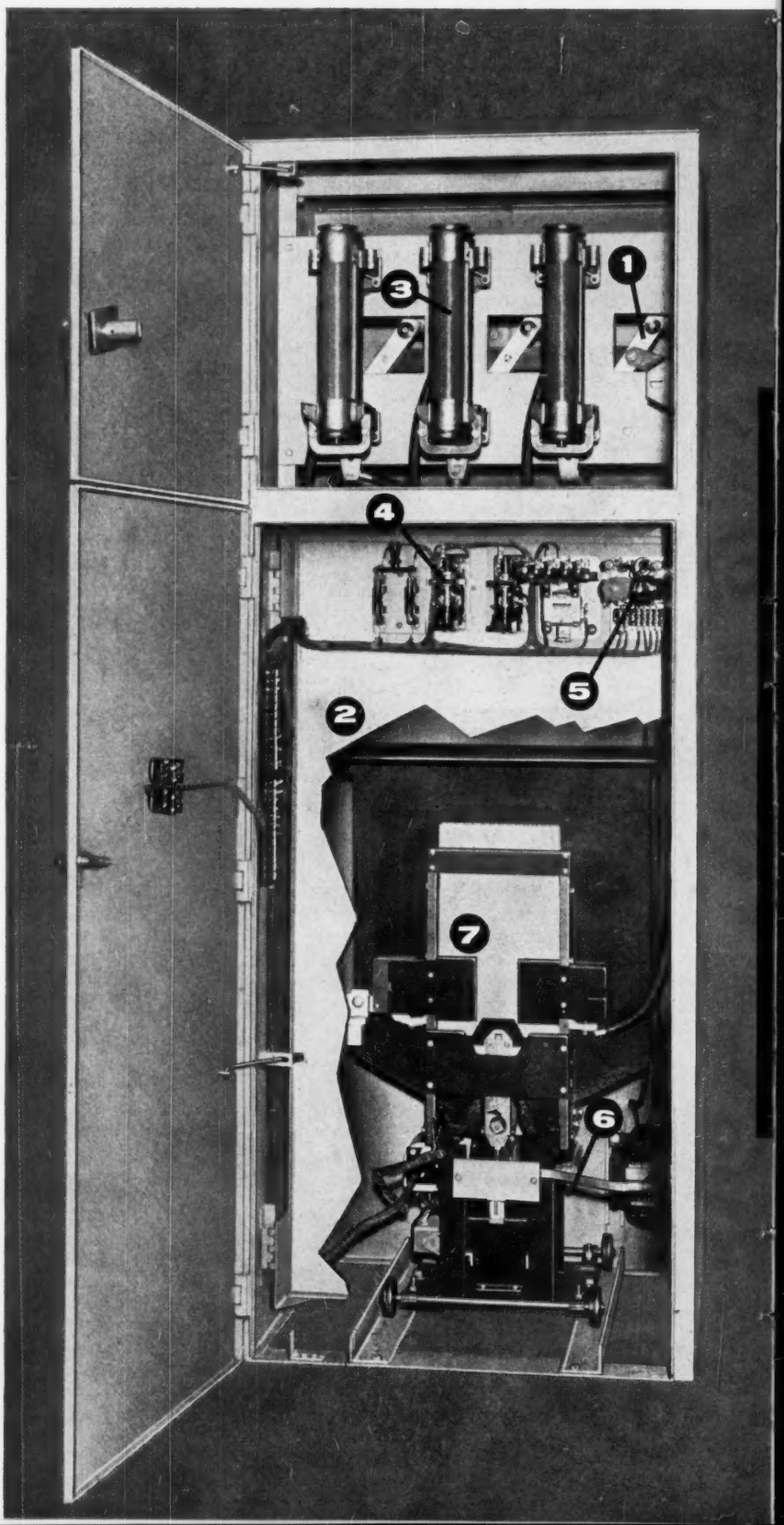
Undervoltage protection instantaneously opens line contactor on loss of voltage. Time-delay undervoltage protection also available.

6

Mechanical interlock coordinates contactor, disconnect switch, upper door and inner control barrier for maximum safety.

7

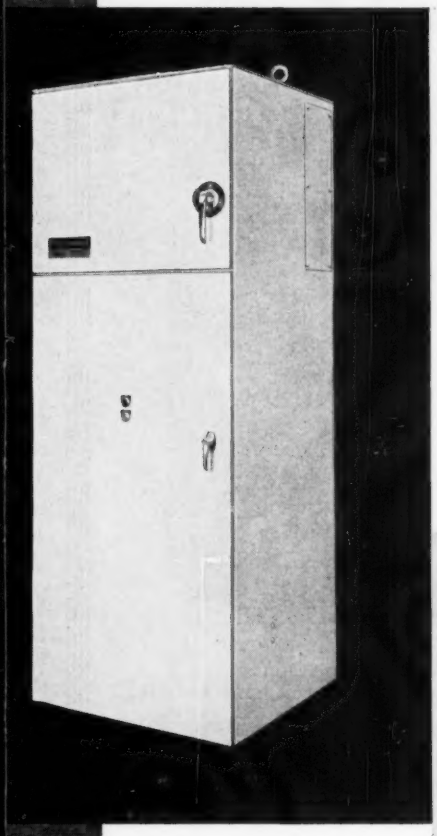
Roll-out contactor makes maintenance easy—even in narrowest aisle space. (Routine inspection and maintenance can be done with contactor in place.)



Designed

Type H High Voltage Motor Control

Combines front access with space economy...

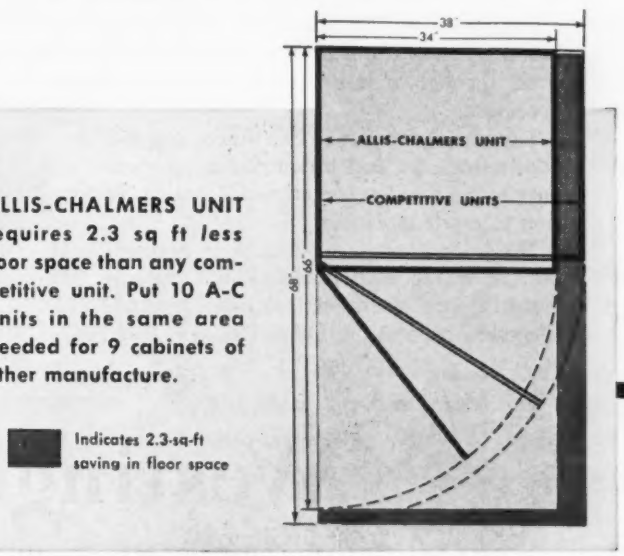


In addition, you get maximum protection for personnel and machines, thoroughly tested components, and ample panel space for modifications. It's all built into the *smaller cabinet* of a newly designed line of Type H high voltage starters from Allis-Chalmers.

Here is control that couples compactness with roominess (for ease of maintenance) . . . here is a starter that joins test-proven performance with versatility (for addition of meters and relays) — AND the line meets every 2300 to 5000-volt motor need.

For more information on this engineering advance, contact your A-C representative or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

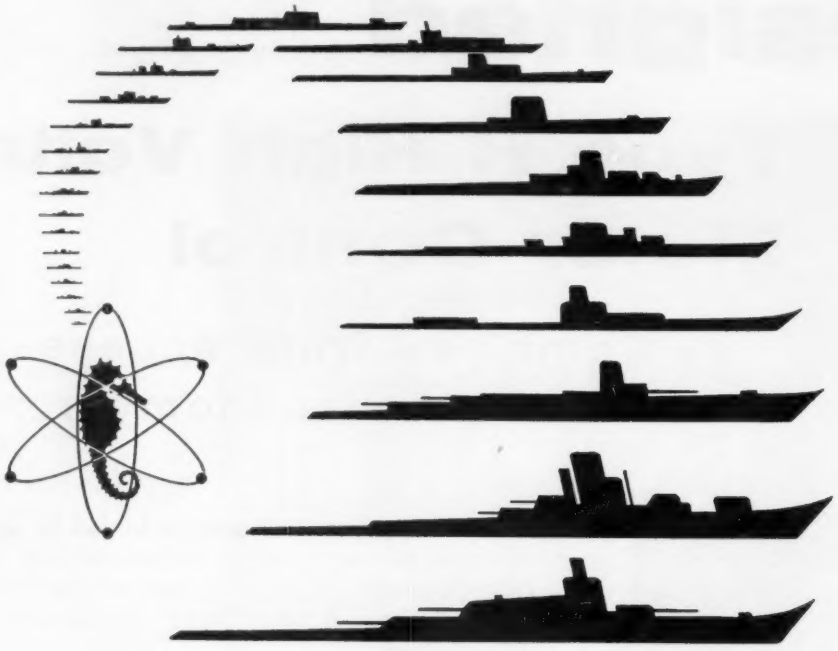
ALLIS-CHALMERS UNIT requires 2.3 sq ft less floor space than any competitive unit. Put 10 A-C units in the same area needed for 9 cabinets of other manufacture.



Indicates 2.3-sq-ft saving in floor space

ALLIS-CHALMERS

A-5517



Nuclear Propulsion for New Navy Takes Shape at Westinghouse

Westinghouse Atomic Power represents one of the largest engineering activities in the nation where marine nuclear power plants have been taken out of the laboratory and put on a multiple-unit production basis.

Engineers in Westinghouse Atomic Power have assignments covering a broad range in the field of nuclear propulsion components . . . from specifications through manufacturing and test follow-up . . . to installation and operations.

No delay for security clearance, you can start working at once. Relocation allowances . . . and unique housing bureau will help you relocate in Pittsburgh, the renaissance city of America. Automatic salary increases, in addition to merit increases.

No prior atomic experience is necessary. If you have a background in pumps, valves, heat transfer, fluid systems, technical procurement, or manufacturing engineering liaison, send résumé to Mr. J. D. Batey, Westinghouse Electric Corporation, Dept. PK-117, Box 1047, Pittsburgh 30, Pa.

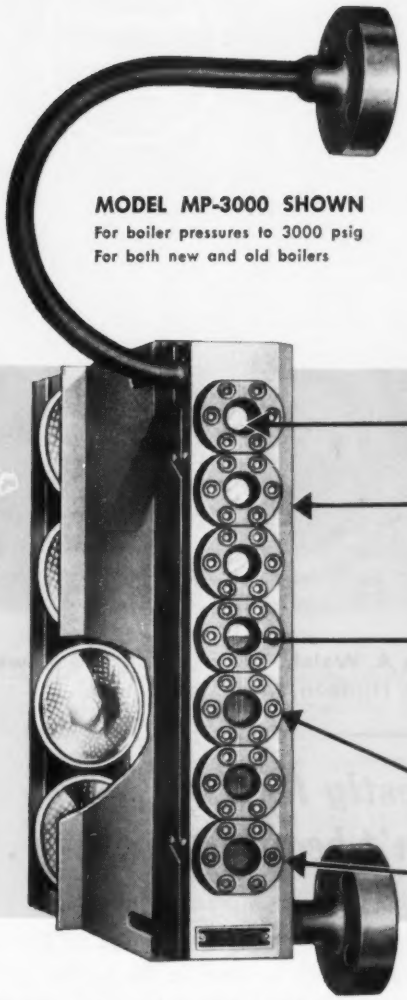
Westinghouse

FIRST IN ATOMIC POWER

...where atoms go to sea

MORE THAN ~~950~~ 1400 DIAMOND MULTI-PORT GAUGES

In use and on order for over ~~240~~ 300 Central Station Generating Plants



MODEL MP-3000 SHOWN
For boiler pressures to 3000 psig
For both new and old boilers

- SMALL ROUND PORTS INSTEAD OF LONG GLASS AND MICA STRIPS
- GAUGE NEVER REMOVED FROM BOILER FOR GASKET CHANGES OR OTHER NORMAL MAINTENANCE
- STEAM SHOWS RED
- WATER SHOWS GREEN
- COMPLETE PORT CHANGE REQUIRES ONLY ABOUT 15 MINUTES
- EACH PORT THERMALLY INDEPENDENT

Also available is Model MP-900 for boiler pressures to 900 psig

Because the Diamond Multi-Port solves the problems inherent in water level gauges on boilers operating at high temperatures and pressures, it has had rapid and wide acceptance. In addition to the 1400 for central station generating plants, more than 150 have been sold to industrial power plants.

Advantages of the Multi-Port are many. In addition to those shown above, it has maximum thermal stability for rapid starting . . . "Hi-Lite" illuminator for improved readability . . . welded construction for permanent tightness . . . end stems can be furnished instead of flanges . . . startling reductions in maintenance costs.

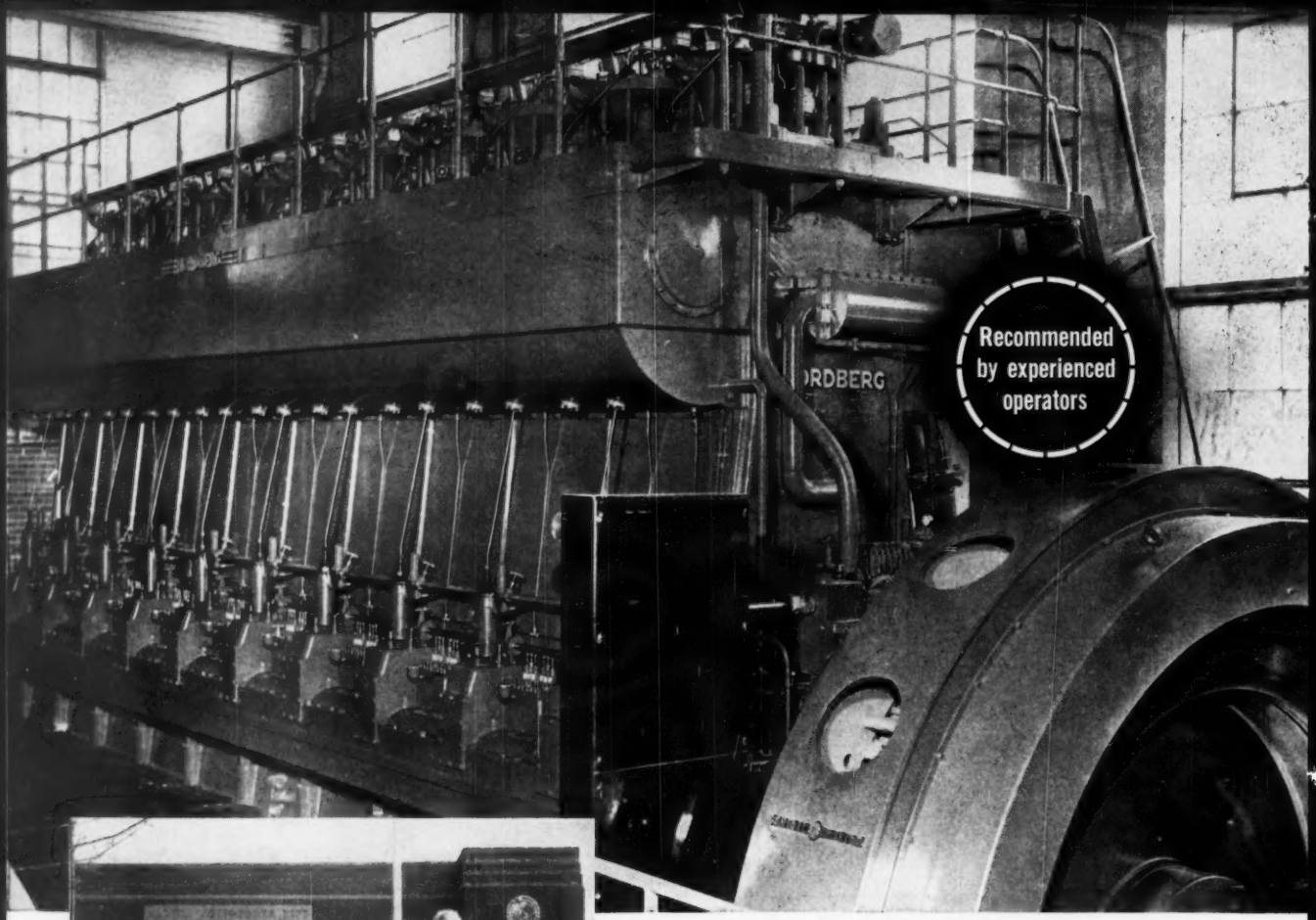
Write for Bulletin 1174U (Model MP-3000) or Bulletin 2044U (Model MP-900) for more information.

7801

Diamond

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO • DIAMOND SPECIALTY LIMITED — *Windsor, Ontario*



Mr. Thomas A. Walsh, Manager, Light & Power Department, Hudson, Mass., says:

"I honestly feel you can't beat a Nordberg . . ."

Mr. Walsh writes: *"Our first Nordberg ran 32,555 hours in four years of operation. Naturally, when we were in the market for another engine we chose another Nordberg. This new engine, a 'duafuel', has only been in operation for a year and a half, and it, too is a 'work-horse' like our other Nordberg. I honestly feel you can't beat a Nordberg for conditions like ours."*

And conditions at Hudson, Mass. are very similar to scores of municipal light and power plants in all parts of the country . . . where economical, reliable, around the clock power is needed to meet the ever-increasing electrical demands. That's why there are so many *repeat orders* for Nordberg Diesel, Duafuel®, and Spark-Ignition Gas engines, from experienced operators like Mr. Walsh. Next time, consult Nordberg on *your* power study . . . builders of America's largest line of heavy duty engines.

NORDBERG MFG. CO., Milwaukee, Wisconsin

Installation Data:
City of Hudson, Massachusetts

Two Nordberg 2-cycle engines of 21½" bore installed, totaling 9350 bhp:

- First engine, a 10-cylinder Nordberg Diesel unit, rated 4250 bhp.
- Second engine, a 10-cylinder Nordberg Duafuel® unit, rated 5100 bhp.

NORDBERG

DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

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P857

LOUIS N ROWLEY, EDITOR • NOVEMBER 1957 • ESTABLISHED 1882 Power

Satellites and straight thinking

FEW SCIENTIFIC accomplishments have caused a public stir like that which greeted the news of the successful launching of an artificial earthgirdling satellite by the Russians. For years the conquest of space has captured the human imagination. It has been the theme of countless science-fiction fantasies and, more recently, of hundreds of serious technical studies. No wonder, then, that a great first step such as the Russians have made provokes a torrent of excited discussion.

A large part of this discussion centers around a re-evaluation of thinking about the potential of Soviet science. This satellite achievement, following hard on the heels of announcement of a Russian intercontinental missile, strikes a hard blow at the school of thought that views the Russians as a nation of backward peasants. It has also given rise to an equally unrealistic picture of Soviet scientists as supermen. We cannot afford either view if we are to live successfully in a world in which the Soviet Union is one of the great incontrovertible facts.

To appraise the true potential of Soviet science and technology we need to view it in the kind of broad perspective given by POWER's October 1956 special report based on Shelton Fisher's first-hand observations behind the Iron Curtain.

That report pictured a land where peasant women still build roads by hand within sight and sound of high-speed jet planes, where nuclear power stations are built while the average home still lacks electricity. These apparent paradoxes stem from one key fact: the Russians have trained a large and able body of scientists and engineers, but this group is small in relation to the total population and woefully small in relation to the enormous task of creating, in a short time, the full-fledged modern economy the Soviet Union seeks.

Thus, those who manage the U.S.S.R. economy have had to be completely ruthless in directing the efforts of their severely limited reservoir of scientists and engineers, and their equally limited industrial resources. They have chosen to concentrate on nuclear energy and on the advanced technologies basic to the aviation and missile fields, have deliberately held to a bare minimum those parts of the economy essential to a balanced and rewarding life for the great masses of the people.

This realistic look at the total U.S.S.R. picture does not in any way diminish the magnitude of U.S.S.R. accomplishments in science and technology. It does make clear that we are competing not with peasants or supermen, but with an able corps of specialists stretching every sinew to achieve success within a chosen pattern.

This is not our pattern, and recognizing the fundamental differences should make it possible for us to go forward with energy and confidence, to resist the hysterical impulse to change our way because theirs has been crowned with temporary success—success paid for, without choice, by a Russian nation still ill-fed, ill-clothed and ill-housed.

KENNEDY

ARE SAVING USERS UP TO $3 PER TON

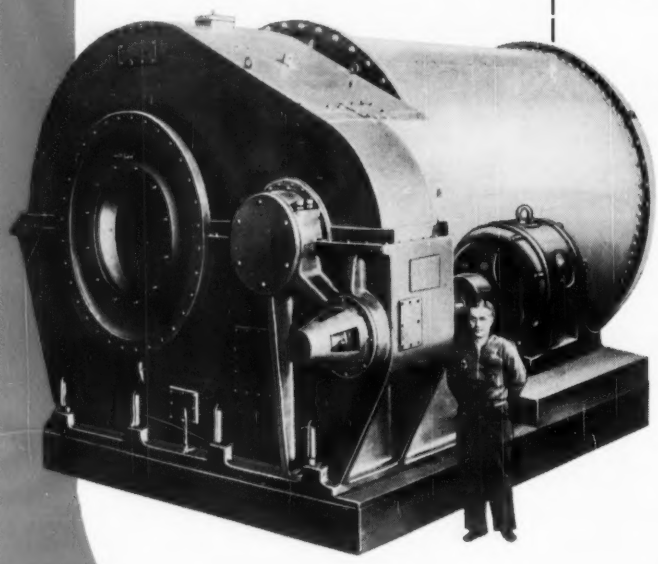
consider these advantages

then...decide for yourself

Large boilers should have fewer and better pulverizers. There is no reason for using more than two mills per boiler.

If your boiler burns coal at the rate of 100 tons per hour, you can pulverize this coal . . . any grade . . . with only two KVS Mills. Why use four when two will do?

Don't accept a "second best" system with high maintenance costs. Insist on a KVS Pulverized Coal Firing System for your boiler – either present or future – and gain the advantages of over-all lower maintenance costs.



AIR SWEPT TUBE MILL

Slow-speed ball mill for perfect pulverization by air separation. Low-cost grinding of all grades of coal regardless of hardness. Grinding balls can be added without shutting down. Continuous year-to-year operation with better than 99% availability. Complete designs for steam and coal installations.

K.V.S. SYSTEM INCLUDES

- UNBURNT CARBON LOSSES LESS THAN ½%
- FULLY AIR SWEPT
- COAL PULVERIZED TO SUPERFINENESS
- COAL COMPLETELY CARBURETED READY FOR COMBUSTION
- BIG TRUNNIONS FOR AIR SWEEPING
- BALLS ADDED WITHOUT SHUTTING DOWN

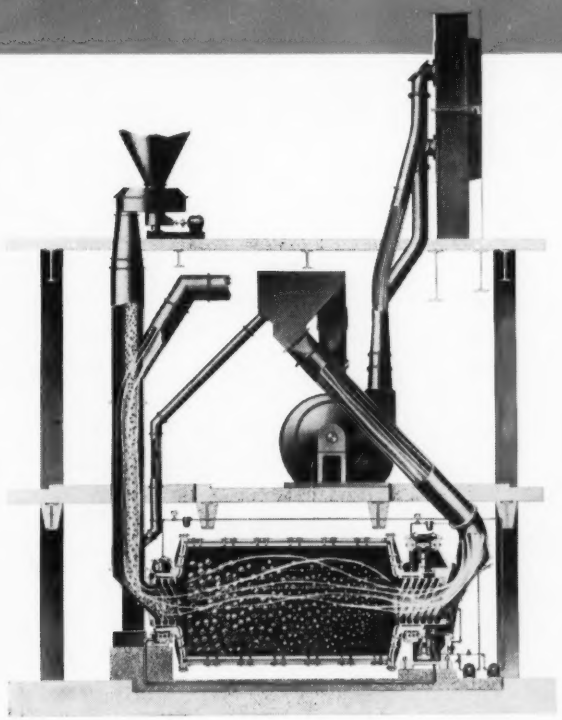
Send for Bulletin describing KVS Machinery and Equipment

KENNEDY–

TWO PARK AVENUE, NEW YORK 16,

PULVERIZERS

. . . ON PULVERIZED COAL COSTS !



COAL FIRING SYSTEM

Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster, burner. Raw coal is delivered to disc feeder and fed into tube mill.

THESE EXCLUSIVE FEATURES

- LOW OPERATING AND MAINTENANCE COSTS
- 85% TO 90% THROUGH 200 MESH
- 20% MOISTURE REMOVED WHILE PULVERIZING
- PULVERIZES ANY COAL—BITUMINOUS, ANTHRACITE, FLUID COKE
- TRAMP IRON ACTUALLY AIDS IN PULVERIZING

consider these savings

In utilizing low priced coals

In low cost maintenance

In producing superfine coal for fast combustion

In availability . . . over 90%

In increased efficiency

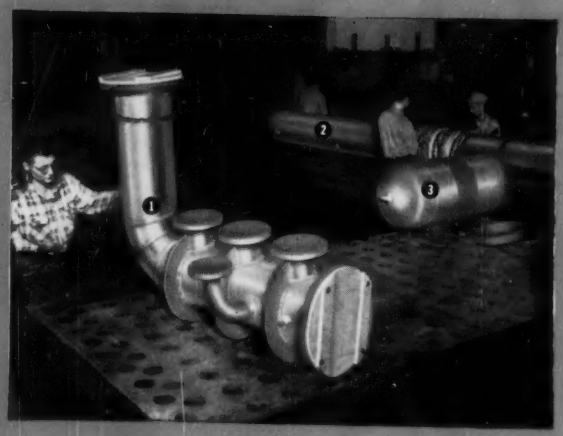
In maintaining a clean furnace

In reducing losses out the smoke stack

VAN SAUN MANUFACTURING & ENGINEERING CORPORATION

N.Y. • FACTORY, DANVILLE, PA.

ALL IN A DAY'S WORK at *Pittsburgh Piping*



These three jobs are typical of the wide variety of custom piping work which we do for the power and process industries. In the background of the photo welders are shown making the heli-arc root pass on 18" O.D., 3.875" wall, chrome-moly main steam piping. In the foreground, ready for final inspection, is a 12" header for a process operation, fabricated of ⅜" aluminum alloy. The pressure vessel, of austenitic steel, is one of many we produce for atomic energy application. The manufacturing of this type of piping requires specialized facilities . . . for engineering, fabricating, testing, assembly, and erection. We have those facilities. Use them on your piping jobs.

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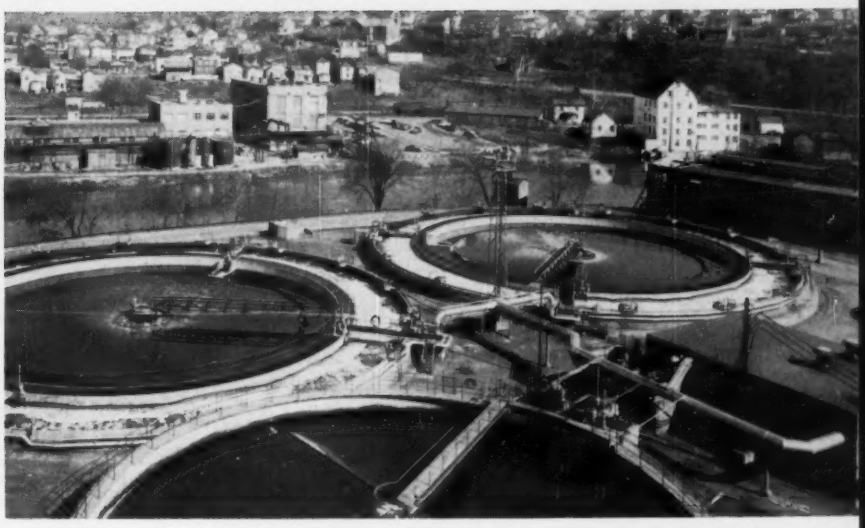
B G A SKROTZKI
Associate Editor in Charge



PERIODIC RECORD CHECK and alarms at control console help waste-treatment plant prevent water-supply contamination

$2,000,000 waste-treatment plant at a large pulp and paper mill is evidence of industry's growing responsibility for waste disposal. Why is it a big problem? How much treatment is needed? What processes are used? An expert gives you the answers in this report on today's methods of . . .

Treating industrial waste

By T L MOORE
Chief Sanitary Engineer
Gibbs & Hill, Inc

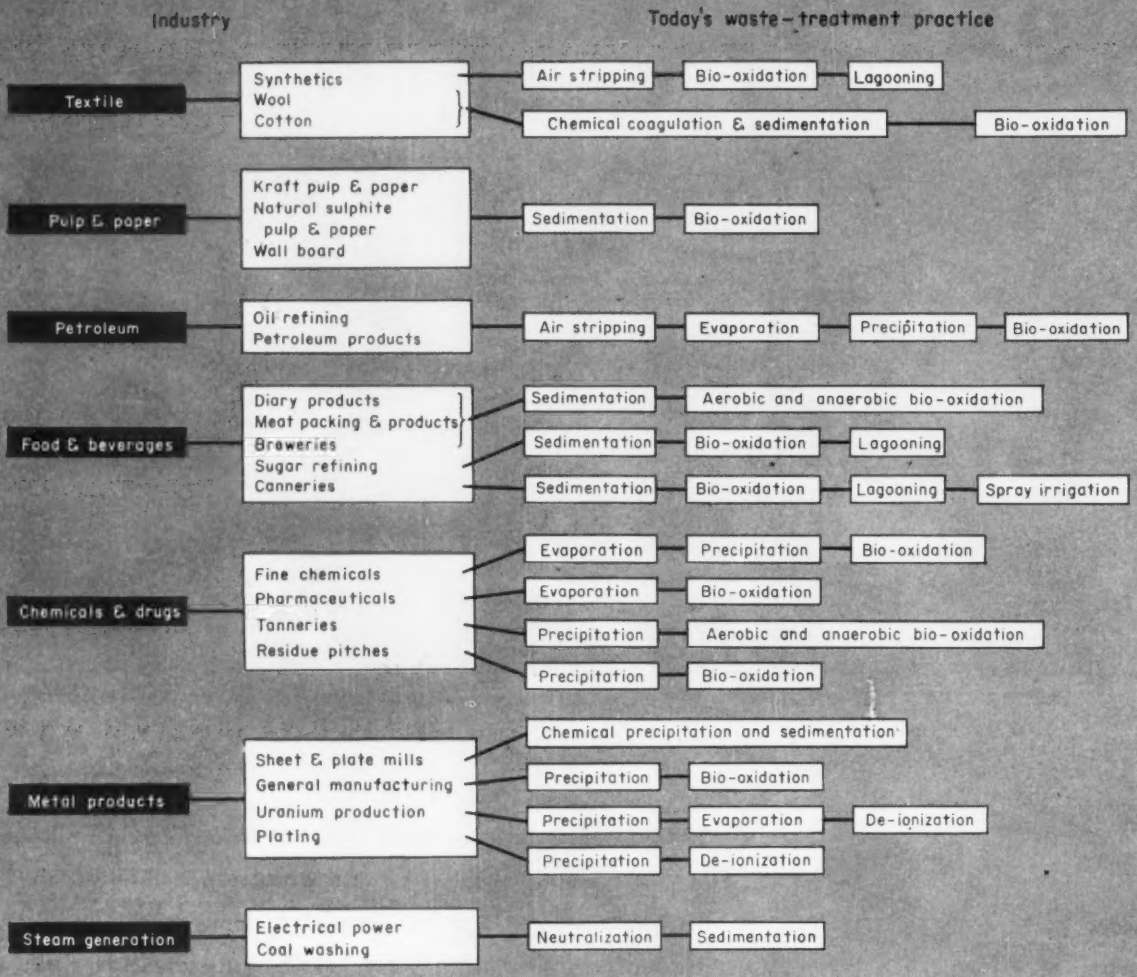
► WASTE DISPOSAL becomes more and more important as state and federal regulations are enacted to protect streams from pollution. Even if not required by law, treatment of waste is good public relations. And it often makes possible recovery of valuable materials as well as usable water.

Industrial growth has upped water demand tremendously and focused national attention on this dwindling natural resource. One result of this trend is that industrial waste volume is zooming to new highs.

For industry even to maintain its present rate of production some of this waste water must be tapped for re-use.

The first installment of this 2-part report explains how to set disposal standards and select the right treatment methods. The second installment will probe the theory behind some typical waste-treatment processes and give examples of their use for today's industrial wastes. **Turn page**

Fortunately, most general wastes yield to treatment



Streams or other water bodies can no longer be considered

Industry has always been concerned about discharging abnormal amounts of unsightly and contaminating wastes into streams. Usually, means are devised to remove at least part of the wastes. But it has been hard to completely break away from the old concept that a stream or body of water is a natural carrier for all waste discharge. The ultimate need is to discharge a quality of water equal to that withdrawn from the stream. Since many streams are already in very poor shape, it may even be necessary to treat plant waste so stream quality is actually upgraded.

All states have the responsibility of fixing standards for water bodies in their jurisdiction. Population growth and industrial expansion are producing heavier pollutional loads at a time of climbing water demand. So state and federal regulatory groups are forced to establish and enforce maximum permissive stream loadings.

Amount of contamination permitted in industrial-waste discharge varies considerably. But it can be determined readily when the state has classified a particular stream.

If the water course is not fully classified, its tolerance for waste assimilation must be surveyed. A joint venture between industry and pollution abatement agencies is usually the quickest way to complete this study.

In general, regulatory agencies will not permit any waste discharge into a stream that can result in a health hazard, nuisance or financial hardship for others.

This broad regulation means that any waste added to a stream must *not* (1) provide breeding places for mosquitos or other pathogenic bacteria carriers (2) cause unsightly and unsanitary bathing beaches (3) interfere with normal fish, vegetable and animal life by depleting oxygen or adding toxic matter (4) damage vegetables receiving water for irrigation (5) scale, corrode or erode water-supply facilities (6) damage boats and docks or increase cleaning costs (7) increase chemical costs of water-treatment plants or make extra equipment necessary and (8) depreciate real-estate values.

Each industry has its own waste problem

Industry	Water demand	General waste characteristics			
	gallons per product unit	Suspended Solids, ppm	BOD ppm	Phenol oil, ppm	pH
Textiles					
Synthetic	180-200,000/ton	10-100	10-30,000	—	3.5- 7.0
Cotton	60- 80,000/ton	1000-10,000	800-1000	—	6.0-11.0
Wool	80-140,000/ton	1000-17,000	200-10,000	—	5.0- 5.5
Pulp and paper					
Unbleached Sulfate pulp	30- 40,000/ton	75-300	100-350	—	7.5- 9.5
Sulfite pulp	50- 60,000/ton	300-800	300-500	—	—
Paper board	10- 70,000/ton	500-700	100-150	—	—
Wall board	15- 30,000/ton	700-1200	200-700	—	5.5-10.0
Paper (drinking)	15- 25,000/ton	2000-6000	250-350	—	7.5-12.0
Petroleum products					
Oil refining	700-800/bbl cr	50-1000	10-30	5-600	8-9
Refined petroleum products	150-2000/bbl	—	—	—	—
Food & beverages					
Dairy products	5-25/100 lb	525-550	800-1500	—	5.5- 8.0
Sugar refining	3-4000/ton	5000-50,000	1000-10,000	—	4.0-11.0
Citrus products	15-300/case	500-2000	200-1000	—	6.0- 6.5
Canned vegetable	25-150/case	20-3500	250-6000	—	6.0- 7.5
Meat packing	300-600/ton	650-1000	900-2500	—	—
Brewery	300-700/bbl	250-650	400-1200	—	5.5- 7.5
Chemicals & Drugs					
Fine chemicals	—	1000-8000	2000-10,000	—	—
Pharmaceutical	—	1300-6000	1300-4200	—	—
Laundry	350-500/100 lb	400-1000	300-1000	—	8.0-10.0
Pine tar products	—	1000-3000	7000-8000	—	3.0- 4.0
Tannery	20-30,000/ton	8000-11,000	1500-2500	—	9.0-11.0
Residue pitches	3000-6000/ton	100-300	10-100	*10-20	7.0- 7.5
Steel					
Equipment mfg.	—	1500-3000	—	*100-150	7.0- 8.0
Highly finished	60,000-70,000/ton	—	—	—	—
Rolled-sheets & plates	10,000-80,000/ton	—	—	—	—
Steam generation					
Electrical power	80-170,000/M kwh	10-100	—	*Trace	4.0-10.0
Coal washing	50-200/ton	1000-5000	—	—	—
Coal mine drainage	—	5000-70,000	—	—	1.0- 7.0
				*COD	

Symbols that may be new to you

BOD	Biochemical oxygen demand, ppm
COD	Chemical oxygen demand, ppm
DO	Dissolved oxygen, ppm
f	Loading factor, lb BOD/day/lb MLSS
K_T	Unit oxygen uptake rate, lb/day/lb MLSS
Lo	BOD of mixed bio-oxidation liquor, ppm
MGD	Million gallons per day
ppm	Parts per million
Q	Flow, MGD or gpm
So	Mixed liquor suspended solids, ppm
MLSS	Mixed liquor suspended solids, ppm
SS	Suspended solids, ppm
t	Time in hours
TS	Total solids, ppm
TVS	Total volatile solids, ppm
VSS	Volatile suspended solids, ppm
R	Recycle

natural carriers for industrial wastes

Control of plant waste has become just as important as electricity, heating, water supply and water treatment. Lowest waste-treatment costs go hand in hand with an integrated in-plant water cycle. This means that wastes are segregated with unusable portions given specific treatment at the point of discharge.

Composited wastes are costly to treat in many industries. They usually require a multitude of separate treatment units to meet optimum conditions for a host of specific waste characteristics.

There is considerable room for improvement in the cost of treating waste. Industrial and government research will eventually lead to marked advances in (a) byproduct development (b) process chemical recovery (c) evaporation and burning of contaminating substances and (d) water re-use.

Table, above, gives the amount of water used per unit of product in a cross section of industry. General waste characteristics are also given. Biochemical oxygen demand (BOD) is the yardstick for organic matter in waste. It's found by measuring the amount of oxygen used for biological oxidation of the organics in a given time (five days) at a specific temperature (20 C). Effective acidity or alkalinity of the waste is measured by pH.

Treatment costs can be minimized by looking into all feasible ways of water recovery and re-use. Recovery of waste materials may be possible. Good plant housekeeping is often overlooked as a way to get dividends by keeping water waste cut to the absolute minimum.

Chart, facing page, covers the general field of industrial waste and outlines today's treatment practice. Data from operating waste-treatment plants, pilot plants and the laboratory prove that wastes from these industries are amenable to treatment.

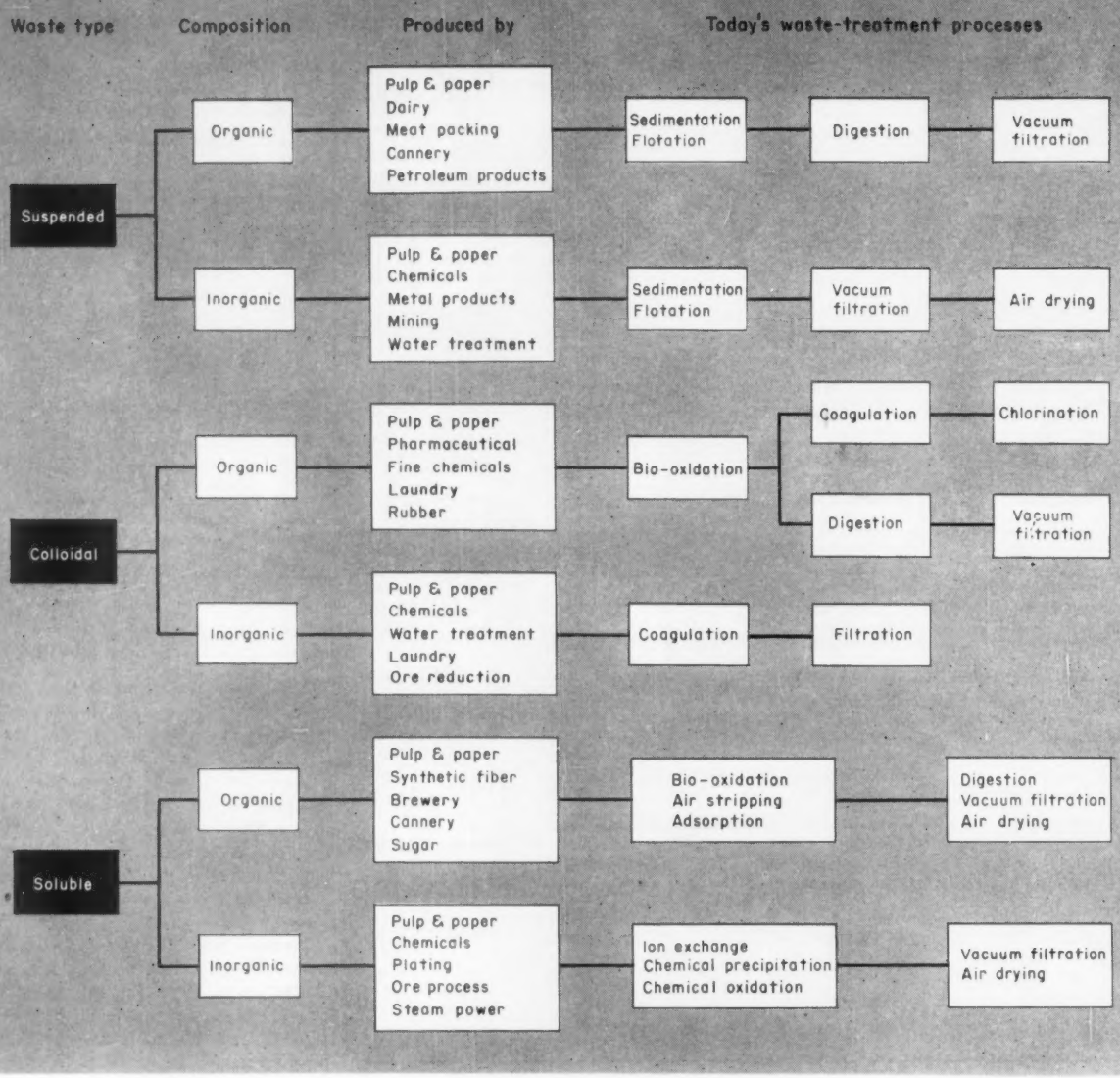
Choosing right method of treatment is a tough job because each installation is governed by the tolerances of the body of water into which the waste is discharged. It's good sense to avoid spending money for a better treatment job than is actually necessary.

First step in any plant waste problem is to find the stream tolerance for assimilation of wastes. This information may already be available. But the chances are good that a stream survey is needed to pin this data down.

Usually, a survey of this type is limited to summer months when low flow rates and high temperatures combine to produce the worst pollution effects. Minimum and maximum flows are gaged. Length of reaches, depths and velocities are measured over the terrain traversed by waste flowing into the stream. Water use and other waste discharges are measured. The stream is analyzed for dissolved and suspended solids, volatile and dissolved solids, color, temperature and dissolved oxygen.

From this survey maximum permissible values are established for (1) settleable and suspended solids (2)

Character of industrial waste controls treatment selection



Today's treatment goal is maximum water recovery and re-use

volatile and dissolved solids (3) toxic materials (4) free acids and alkalies (5) mineral and soluble oils (6) color and temperature (7) biochemical and chemical oxygen demands.

Box, facing page, summarizes the steps to take when tackling a plant-waste problem. This is followed by a roundup on the importance of pilot-plant data in waste-treatment selection.

Plant-waste survey is the next step. Gaging, sampling and analysis is carried out for each process discharge and for the total composite flow from the plant. Weirs, orifices, nozzles or venturies can be used. Selection is made on the basis of installed location, sampling periods, and pressure and character of the liquid. Sampling devices of both the home built and purchased type can be used. Recorders give an excellent record of the complete flow picture. The importance of representative samples cannot be overemphasized.

Waste composition data should include information on (1) sediment, volatile compounds, temperature, color, corrosiveness and oil (2) acidity and alkalinity, acid sludge and brine, dissolved oxygen, metallic ions, coagulants, nitrates, sulfates and chlorides, suspended and dissolved solids and organic matter (3) hydrocarbons, fibers, grease and gelatinous matter, amines, inhibitors, soaps, detergents, starch and fillers (4) BOD, fungi and toxic materials.

Pilot-plant selection and operation is the last step. This will positively determine the basic data necessary to design the waste-treatment plant.

For bio-oxidation treatment the pilot plant should be set up to produce design information on primary sedimentation, fixed or fluid bed aeration, final settling, nutritional needs and sludge excess.

Here's how to tackle a plant waste problem

First, run a thorough stream survey. It takes time and effort, but it's the only way to get an accurate estimate of stream tolerance for waste.

Second, begin a gaging, sampling and analysis program in the plant to pin down flow and waste characteristics. Include both individual and combined flows and get representative data for minimum, maximum and average conditions. Curves, right, are plotted from typical survey results.

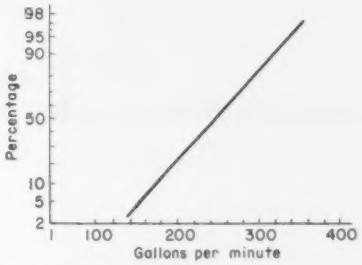
Analysis of wastes can often be made in your own laboratory. Use the American Public Health Association "Standard Methods" with proven modifications for complex solutions.

Working closely with pollution abatement agencies, research groups and waste-process engineers saves time by reducing the amount of fact gathering. Discussion and legal arbitration may be necessary to decide which portions of the stream can be left as they are and which must be improved.

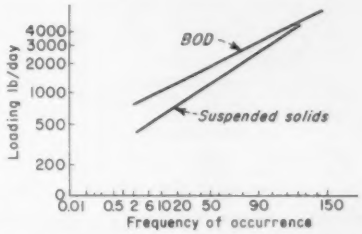
Third, if treatment is necessary, evaluate available methods in the laboratory. Actual operating results for various treatment methods can then be prepared for preliminary evaluation.

Look into all available means of waste recovery and re-use of byproducts. But don't count on byproduct recovery to pay for the entire cost of treatment operation. Primary reason for treatment is pollution abatement although water recovery is a dividend of increasing value.

Finally, set up a pilot plant at the site to obtain operating data from the treatment processes selected. This will verify laboratory results and provide a firm basis for final design of the waste treatment plant selected.



PROBABILITY PLOT helps to tie down minimum, average and peak design flows



LOADING RATE FREQUENCY, plus duration data, fix the plant's design capacity

What you should know about pilot plants

Industrial-waste characteristics vary widely from plant to plant and even fluctuate in the same plant. So while there's a lot of operating data from existing installations, it's hazardous to rely only on them for new plant design. The risk might be worthwhile on some smaller jobs, but for most waste flows a pilot plant is necessary.

Pilot-plant operation is critical because any inaccuracy will be directly reflected in the full scale plant. Careful laboratory analysis and control is a must. And the plant must receive composite wastes under actual operating conditions over a reasonable time.

Use laboratory results to set performance standards for the pilot plant. Establish reasonable effluent ranges for (1) pH (2) alkalinity (3) chemical oxygen demand (4) biochemical oxygen demand (5) color transmission (6) total solids (7) total volatile solids (8) suspended solids (9) volatile suspended solids (10) ammonia and nitrogen.

When bio-oxidation treatment is considered, equip the pilot plant to handle an investigation of the following four functional processes.

(1) Primary sedimentation to remove any organic or inorganic matter that will settle out.

(2) Aeration of mixed waste and biologically active sludge, or distribution of organic waste over microbial growths attached to filter media.

(3) Separation of biological sludge from treated liquor by sedimentation.

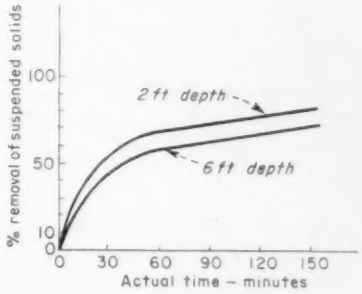
(4) Return of settled biological sludge for admixing with raw waste.

To successfully operate a bio-oxidation pilot plant, the system must be in biological balance at all times. Usually the synthesis of organic matter to new sludge means feeding nitrogen and phosphorus. Oxygen must be supplied to oxidize organic matter taken from the waste. Excess sludge produced by the synthesis of organic matter to bacterial protoplasm has to be removed.

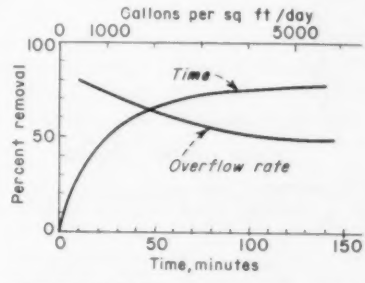
Basic pilot-plant aim is to get design data. For example, sedimentation tests will yield (1) rate of settling for suspended solids at various concentrations and the percent reduction in solids over the expected range (2) percent reduction in BOD over this same range (3) amount and concentration of sludge produced.

Suspended solids and BOD reduction vary with flow, temperature and type of coagulant. So these factors must also be considered in the evaluation of the pilot-plant results.

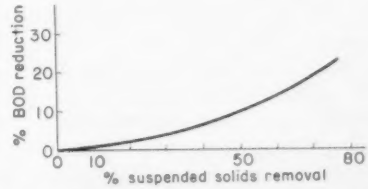
Curves, right, are plotted from typical pilot-plant operation data. This information on detention time, depth of tank and sludge capacity forms the basis for the design of a full-sized clarification unit.



SUSPENDED SOLIDS REMOVAL tapers off rapidly after 60-min settling time



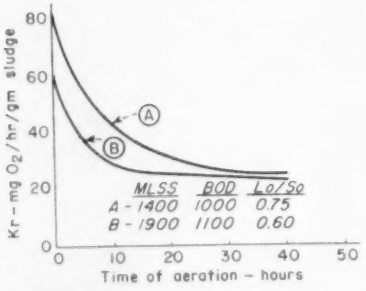
OVERFLOW RATE and sedimentation time are factors in suspended solids removal



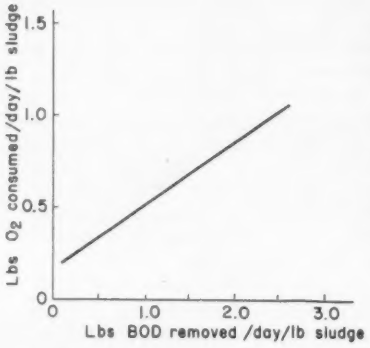
BOD REDUCTION climbs with each improvement in suspended solids removal

Turn page

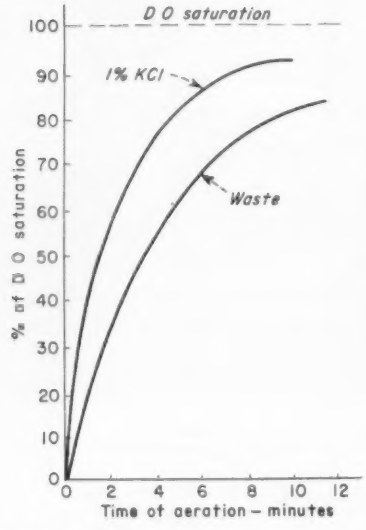
Carefully analyze pilot plant operating data



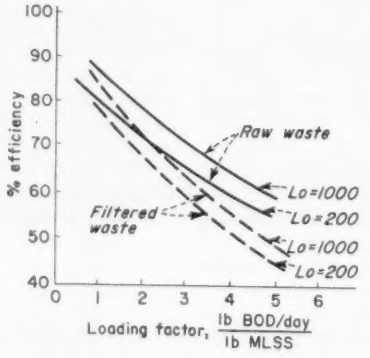
OXYGEN UPTAKE RATE of the sludge rapidly levels off after 10 hr aeration



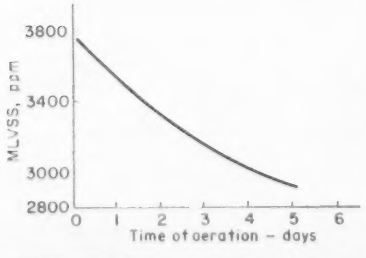
OXYGEN NEED for bio-oxidation waste treatment is based on the BOD reduction



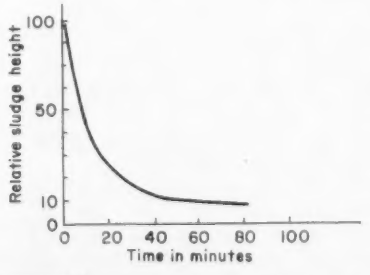
DO CONTENT of the waste rises quickly with a relatively short aeration period



LOADING FACTOR for optimum results varies greatly with the waste analysis



MLVSS CONTENT of waste is reduced by aerating bio-oxidation sludge and waste



SETTLING TIME of biological sludges is a good measure of relative compaction

Aeration (fluid or fixed bed) studies are started only after laboratory confirmation that the required reduction in BOD is within reason and possible.

Pilot-plant runs will help to fix optimum need for return sludge solids, quantity of mixed liquor suspended and volatile solids, oxygen use rate and transfer efficiency, quantity and size of fixed bed media and BOD loading over the operating range.

Curves, left, are plotted from some typical pilot-plant operating data on the aeration process. Symbols used are explained in box, top of page 73.

Final settling. Equipment for this process is designed from standards for detention time, tank depth and amount of sludge produced. These are projected from pilot plant data on:

(a) sludge settling and compaction characteristics
(b) percent of nitrogen, volatile and inert solids
(c) oxygen uptake rate
(d) effluent suspended solids

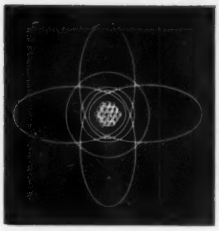
Nutritional needs. Experimental studies show nitrogen and phosphorus needs are a percentage of net biological solids. By allowing for nutrients present, the amounts that have to be added to maintain a biological balance are readily computed.

Sludge excess. Sludge-disposal method depends upon particular facilities and topography at each plant. Dewatering can be done with thickeners, filters or open drying beds. Another solution is to use anaerobic digestion followed by drying and incineration.

Waste-treating methods for a given type of waste are presented in chart form on page 74. Processes that are avalable for selection include:

(1) biological oxidation with aeration tanks or biological filters
(2) chemical precipitation, flocculation and sedimentation
(3) anaerobic digestion (decomposition without oxygen)
(4) ion exchange
(5) neutralization to prevent corrosion and scaling
(6) flotation to remove low density solids
(7) evaporation and stripping for those untreatable wastes
(8) lagooning and spray irrigation for acceptable geographical areas
(9) sludge thickening and drying to dispose stable solids

This is only a partial list of the many treatment methods available today. Next installment will explain how the most frequently used processes work. Flow diagrams of equipment hookup will show how they are applied most efficiently in the treatment of typical organic and inorganic industrial wastes.



Nuclear notes

By B G A SKROTZKI, *Associate Editor*

Fast action marked industry's response to AEC's invitation for proposals to build a 40-mw-electrical natural-uranium graphite-moderated gas-cooled nuclear power plant. At direction of U.S. Congress, the AEC issued invitation on August 31 with deadline of September 23 for receipt of proposals. Total of 31 architect-engineer firms responded. AEC selection board is now evaluating proposals. Report on design, cost estimate and construction schedule must be made to Joint Committee on Atomic Energy not later than April 1, 1958.

Over 900 possible types of nuclear reactors could be built with different combinations of neutron speed, fuel type, fuel form, moderators and coolants. After evaluating engineering problems only about 50 of these are worth detailed study. When faced with factors of cost, materials availability and corrosion, only about a dozen are worth building and testing. Only actual testing and operating experience can narrow these down to the practical, competitive heat producers.

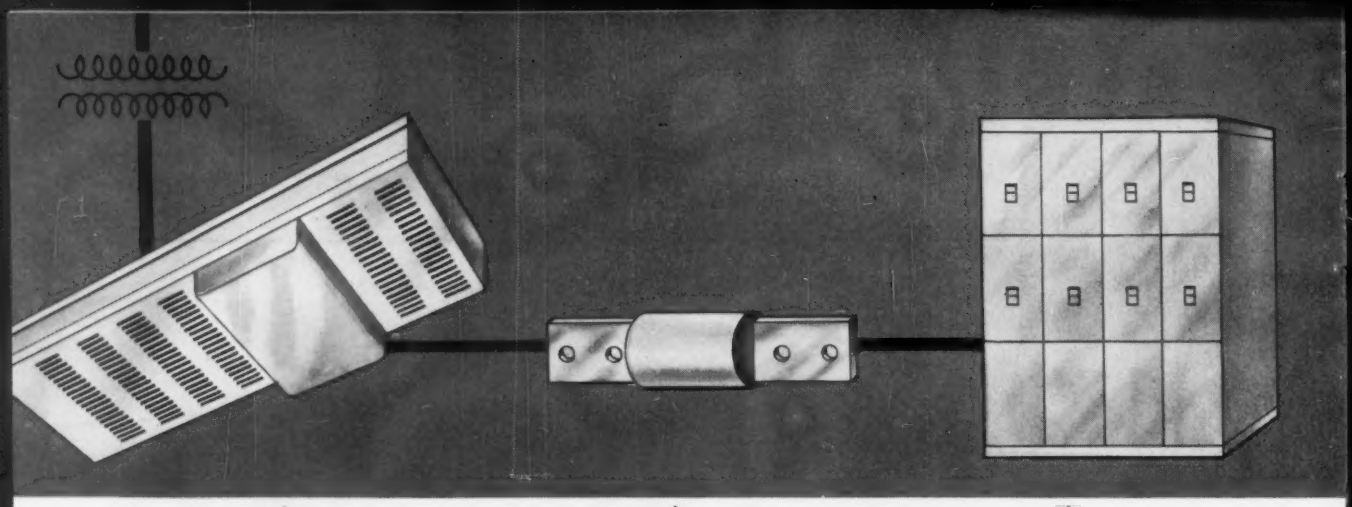
Organic Moderated Reactor Experiment developed by Atomics International for the AEC went critical on September 17, at the National Reactor Testing Station in Idaho. This new type reactor uses an organic fluid, a carbon-hydrogen compound—terphenyl—for dual role of moderator-coolant. At full power, reactor will generate about 16 mw of heat.

Controlled fusion may be a fact according to latest British experiments at their Harwell Laboratory. Newly installed torus discharge apparatus appears to be creating plasma with temperature of 1,800,000 F for periods about a millisecond long. Neutrons emitted from reaction seem to be definitely of fusion origin. This achievement still falls far short of 90,000,000 F needed for power generation. At this level power output will exceed energy input needed to activate plasma.

Foreign nuclear plants will provide some business for U.S.A. manufacturers of atomic power plant equipment, according to annual report of Atomic Industrial Forum. Six-nation European Atomic Energy Community (Euratom) is projecting total of 15 million kw by 1967. Spain and Scandinavian countries are starting nuclear programs of importance. Japan plans at least 1 million kw by 1965.

Hard lessons of experience in U.S.A. show that nuclear power development is tough and costly—more than originally anticipated. Economic and profitable atomic energy generation seems farther off in the future than first estimated; especially when compared to relatively cheap fossil fuels now available here. England and Europe, squeezed between growing power demands and diminishing fuel reserves, already face rocketing costs of imported fuels. This makes it easier to prove in costly nuclear power. Their needs may help keep our atomic industry going by furnishing a market for equipment while we keep pushing development and research.

Growing isotope savings now have reached over $400 million annually according to latest AEC study. Industrial applications of isotopes include: thickness gages for cigarette density, metal, rubber and tire fabrics, plastic and adhesives, paper; gages for: liquid level, moisture, hydrogen-carbon ratio, snow; radiographic testing, oil-well logging, oil-well stimulation, pipeline oil flow, petroleum refining, tool wear, piston-ring wear, corrosion studies, luminescent sources, industrial research. Oil-well stimulation saves about $150 million annually.



1 **Feeder busway,** current-limiting, does job of a reactor as well as transmitting power. Top practical limit on size right now is 6000 amp

2 **Current-limiting fuse** with single main switch can protect group of molded-case circuit breakers in plant panelboard or switchboard

3 **Molded-case breakers** having a wide range of sizes should be grouped into separate panelboards, large in one, small in other

Bus-fuse-breaker teamup for low-cost

► EVER SINCE the Power to Grow . . . *electrically* editorial program bowed in (Sept 1956) there have been some engineers who say, "Sure, PTG is a fine idea, but. . . ." And the "but's" go on to outline the purse-string problem. These comments point up the need for a low-cost system which will do a good job at high short-circuit current levels with no compromise in safety.

A 3-part system. Every industrial electrical engineer agrees that the highest degree of service continuity is maintained when fully rated circuit breakers are used throughout. This is basic in view of the wide variety of breaker trip characteristics available plus the fuse-replacement problem where fuses are used. But cost is often the stumbling block. So the 3-part approach is coming into the picture: *current-limiting feeder busway* with a controlled let-through current, say 100,000 amp; *current-limiting fuses* having a known let-through energy in amp squared seconds (I^2T); *molded-case circuit breakers* in panelboards. Busway, switchboards or motor-control centers having a known short-circuit rating could be used in place of the molded-case breakers.

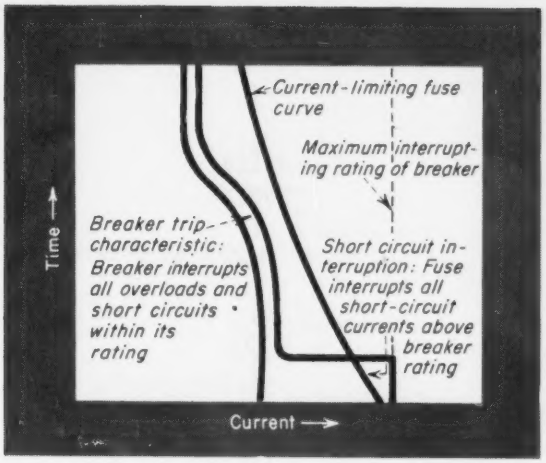
Before delving into the low-cost 3-part approach to circuit protection, mentally roll back the years to the low-voltage electrical-distribution picture in the 1930's and early 1940's. Remember the wide gap that existed between the calculated values of available short-circuit current and the protective gear finally bought for the job? During that era calculating available short-circuit currents had become a national pastime for electrical engineers. Some referred to it as "short-circuit religion." All too often the calculation was an end in itself since the maker-of-the-budget couldn't be convinced of the real need for buying adequate interrupting capacity.

Increasing demand on the part of power-service engineers for higher IC equipment indicates several things. First, the philosophy of sizing electrical gear to short-circuit current needs is getting across. Second, although the philosophy is being accepted, the first cost of a fully rated all circuit breaker installation is getting tougher to swallow in many quarters.

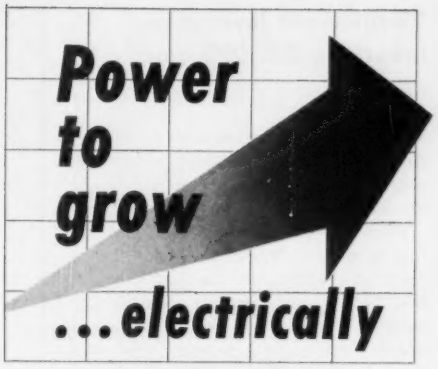
One answer. The current-limiting, C-L, fuse has stepped in within recent years and carved its own niche. But that's only part of the story. A more complete approach was recently outlined by L E Fisher and J D Hamilton of General Electric's Distribution Assemblies department in Plainville,

Relative cost of low-voltage protection

Frame size, amp	225	400	600	800
Large air breaker, %	100	100	100	100
Interrupter switch with C-L fuses, %	46	41	55	40
Molded-case breaker, %	37	37	45	30
Molded-case breaker with C-L fuse, %	78	64	85	53
C-L molded-case breaker, %	84	64	87	—


Current-limiting fuse curve
Maximum interrupting rating of breaker
Time
Breaker trip-characteristic: Breaker interrupts all overloads and short circuits within its rating
Short circuit interruption: Fuse interrupts all short-circuit currents above breaker rating
Current

AVOID NUISANCE BLOWING of fuse by keeping its characteristic curve from intersecting knee of circuit-breaker trip curve



NO. 12: CURRENT LIMITING

current-limiting circuit protection

Conn. They are proposing the 3-part approach (C-L busway, C-L fuses, molded-case breakers) as a practical answer to industry's need for a low-cost system. Now, let's look closely at each of these three parts and see how they could be dovetailed.

C-L busway. In some commercial buildings and small industrial plants the available short-circuit level approaches 200,000 amp rms asymmetrical. And since few protective devices are available with an IC above 100,000 amp, and such gear is costly, the need is pressing for ways to bring the short-circuit level down. C-L busway does the dual job of a reactor and power transmitter. To get high reactance in C-L busway, bus bars are arranged in widely separated phase groups. Result: a 10-ft length of C-L busway has, in some sizes, more current-limiting ability than a 200-ft length of the standard low voltage-drop busway. In one industrial plant a 2000-amp C-L busway reduced short-circuit level to 50,000 amp. Today, 5000- or 6000-amp C-L busway is about the upper practical limit because of voltage drop.

C-L fuse is the next link in the low-cost approach to coping with high short-circuit currents. As pointed out by GE's R C Wilson, if the only job a C-L fuse had to handle was short-circuit protection, and the fuse was the only protective device in the system, application would be relatively simple. But this is not the case. Often the C-L fuse provides overload plus short-circuit protection. In most installations the C-L fuse must be co-ordinated with other circuit elements. Curves are available from fuse and breaker manufacturers to help you do this job (see typical curve, above, for a molded-case breaker and C-L fuse co-ordination.)

Although the peak let-through is of interest, this value does not serve as the basis for applying C-L fuses. By defining let-through in terms of I^2T you get a composite quantity indicating both thermal and mechanical stresses. The time in this relationship includes both the melting and arcing time of the fuse element.

At present, electrical conductors are the only circuit elements, according to Wilson, whose withstand-limits have been defined in terms of I^2T. With time, there will be an increasing fund of this knowledge governing other circuit elements. Until that time comes, manufacturers rely upon actual test data in applying C-L fuses on a let-through basis.

Molded-case breakers, the third element in the current-limiting scheme, generally are spotted in panelboards fed through C-L fused feeders. Circuit breaker performance is quite satisfactory where properly protected by a C-L fuse. Current-limiting action of the fuse during severe short circuit limits let-through energy to a level which will not damage or disturb calibration of breaker trip element.

On overloads or relatively low-level faults, the breaker trips clearing the circuit without damage to fuses. But to get this clearcut action of the two components, proper sizing is necessary.

One feature of the fuse-breaker team is that one main switch with C-L fuses can protect a whole group of molded-case breakers in panelboard or switchboard. Use the largest possible main fuse to prevent nuisance blowing. For this reason it's wise to avoid a wide range of circuit-breaker sizes in the panelboard. Where the range is great, it's better to split up the group into two panelboards: place larger breakers in one panel, smaller in another. An alternate is to use split mains in a single panelboard, grouping all small breakers with a backup fuse and larger breakers with another.

Remember, minimum fuse size is influenced by the circuit breaker's adjustable trip setting. With a wide range of breaker sizes in a single panelboard, it may be necessary to use the lowest setting of the largest breaker's trip. Where a smaller size fuse is used, that is, smaller than indicated in manufac-

turers' recommendation tables, you may run into nuisance blowing even with current values eight or ten times the breaker ratings.

Partial selectivity of this busway-fuse-breaker combination may be a point of objection on the part of some. But before objecting they should remember that very few low-voltage systems are truly selective. Thus the 3-point current-limiting system is as selective as most of the low-voltage systems now in use in both commercial buildings and industrial plants.

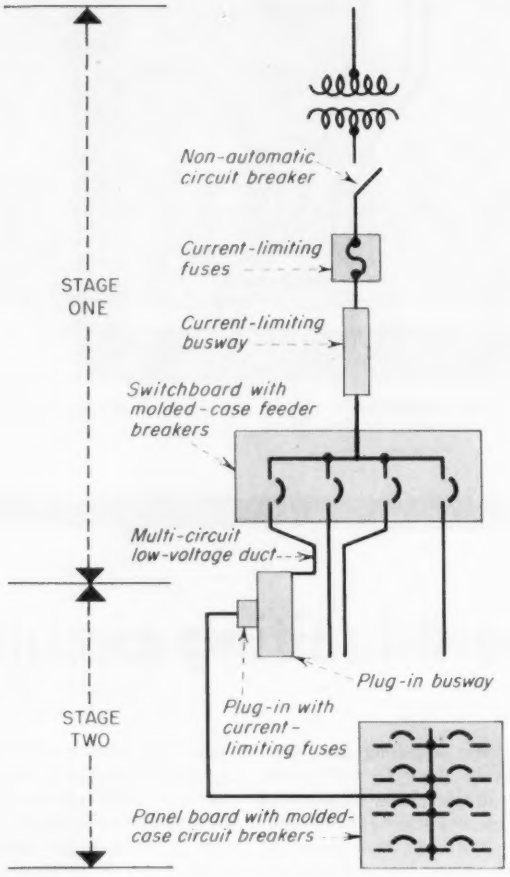
All agree that high-current short-circuits are rare occurrences. So time needed for replacing C-L fuses is a minor factor when stacked against the true downtime cost if a short occurs when a system isn't properly protected.

C-L system assembly. Simplest C-L system, using the 3-part package, is shown on p 78. Here the C-L busway may reduce short-circuit level to 50,000 or 100,000 amp at the switchboard. Switches with C-L fuses (up to a maximum of six) at the switchboard protect feeders running to panelboards housing molded-case circuit breakers. One example of such an application on a truly large scale is found in the New York Coliseum (POWER, March 1956, pp 80-81).

In between these two extremes of a very small and a very large C-L system there are numerous possible variations. You could use all the different normal elements such as switches, circuit breakers, lighting panelboards, distribution panelboards, motor control centers, switchboards, busway systems, plus the C-L elements of the 3-part C-L system. It's simply a matter of arranging the elements in the system to use the proper combinations of C-L fuses and molded-case circuit breakers.

One interesting variation is the use of C-L fuses in main switchboard to protect different circuits in a multicircuit low voltage-drop busway. Latter is a busway having a number of bus bars connected as individual circuits in one enclosure. These circuits might feed panelboards or runs of plug-in busway containing molded-case circuit breaker plug-ins.

Non-automatic breakers look promising as switches in a C-L system. Greatest advantage is their more than adequate overload ability. Non-automatic simply means removing the over-current trip device so breaker operates as a switch. Both air and molded-case breakers are available in this type.



Two-stage current-limiting systems

It's quite possible to have two stages or more in a true C-L system. Schematic, above, of a 2-stage system is completely selective for all short-circuit and overload values from one stage to the other.

This system breaks into a main C-L feeder busway running to the switchboard, co-ordinated with molded-case feeder circuit breakers. The latter serve as protective devices for the many different circuits in runs of multicircuit low-voltage feeder busway. In general, fuses in the second stage (at point of busway plug-in) don't exceed one-half of main fuses.

C-L fuses in second stage act as protection for the sub-feeders from busways with molded-case breakers used as the final branch-circuit protective device. A heavy short-circuit in second stage, even up to 100,000 amp, blows the second-stage fuse but not the main.

By **NORMAN PEACH**, *Assistant Editor*

The McGraw-Hill Building

We air conditioned our big New York building, and with expected growth of lighting and business-machine loads we've had to find . . .

Ways to squeeze in more electric power

► WHAT HAPPENS when a large commercial building suddenly more than doubles its electric-power needs? We've found out here at our 34-story New York headquarters, and have gotten ourselves an up-to-the-minute electrical distribution system with power to grow.

Decision to air condition the entire building came after a year's trial on two floors where personnel concentration is heaviest. High efficiency and good dispositions were maintained through the steamy summer when normally a lot of activity is involved in simply mopping the brow.

Typical floor now has two 15-ton units; some floors have more or fewer, depending on worker density. Individual units are rated 7½, 10, 15, 20, 25 and 30 tons. Condenser water cooling system has 14 cooling towers that are located on roofs of building offsets. Seven of the towers have individual pumps and fans; the others are served by two separate 50-hp pumps. On a few of the floors where special temperature problems exist, electric heaters are employed to reheat the air, when necessary, in order to maintain the desired temperature. All this adds up to a sizable electric load, acquired all at once.

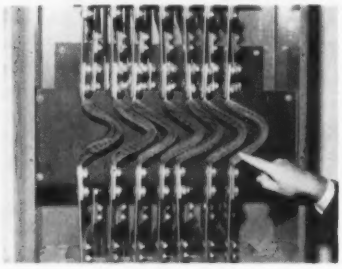
In addition, plans call for installation of more business machines and new, higher-level lighting in some areas. To meet the air-conditioning and future loads, three new utility services were installed. Each new service is 3500 amp, 208 volts, 3-phase, 4-wire, totalling 2200 kva. Previously installed capacity consists of two 4000-amp services, or about 1660 kva.

Biggest problem was finding space for the new system in a building where practically every square foot is put to efficient use. Luckily, we did have a spare elevator shaft; but this had been converted into a closet on most of the floors. After relocation of doorways, and installation of fireproof doors and ventilators, busways were run through the series of closets made out of the spare elevator shaft.

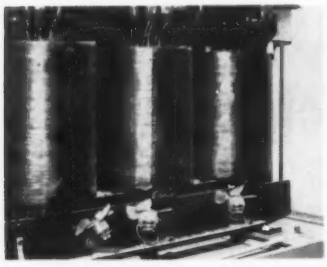
Prefabricated low-impedance aluminum busway is used for the risers and for the runs between the switch room and the risers. Riser ducts are supported on each floor. Fire barriers are included in the duct. Concrete curbs were built around the openings in the floor through which the busways pass. Curbs are intended to keep water from entering busways in case a flood should occur on one of the floors as result of a broken pipe or other cause. Continuous aluminum covers were

Unanticipated load growth in commercial buildings

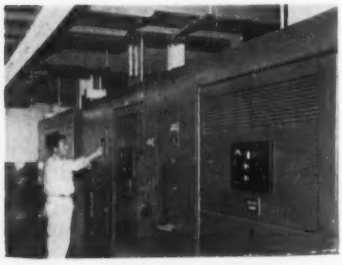
CONTROLS are centralized where possible. Pilot lights aid check on operation



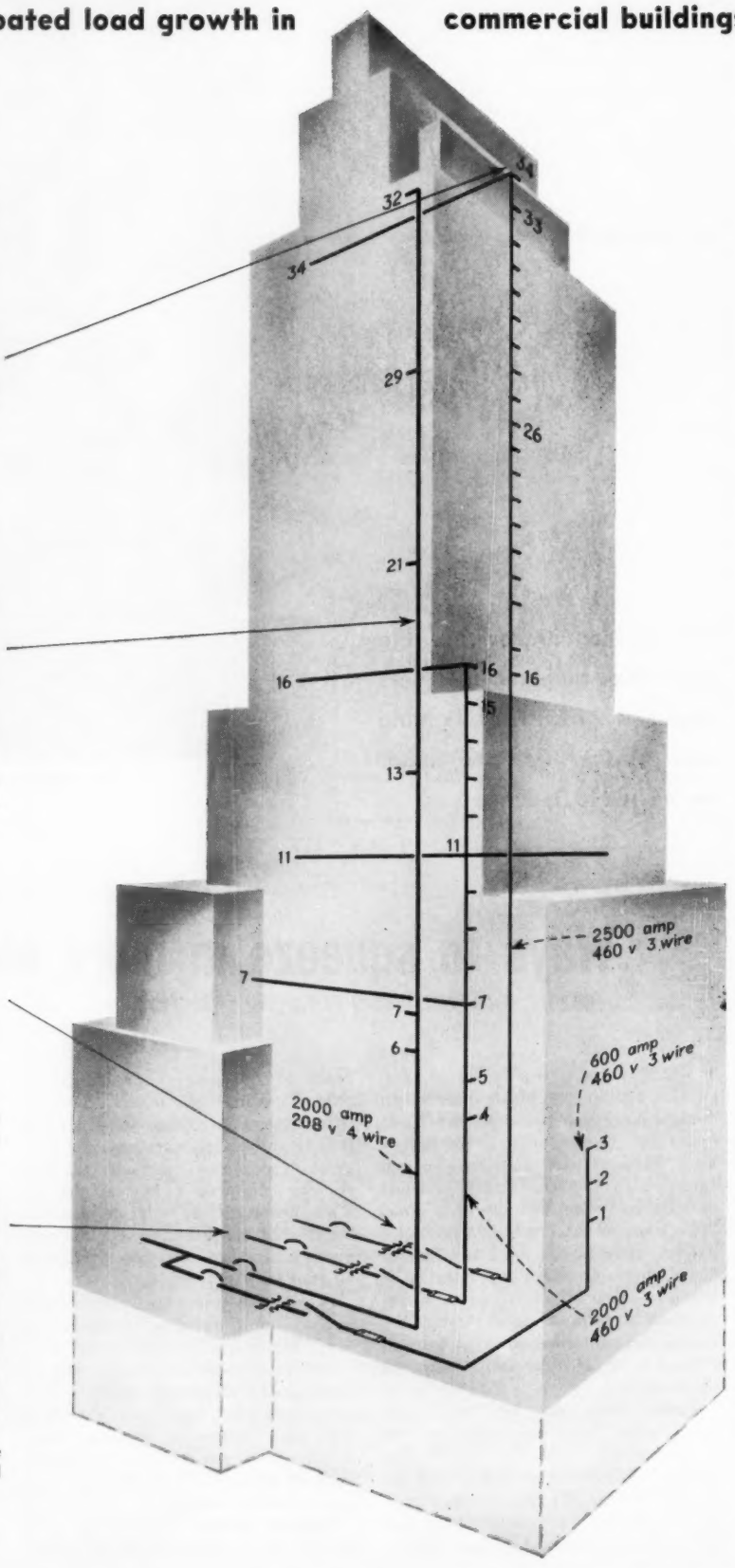
EXPANSION JOINTS prevent strain and distortion of long aluminum busway risers



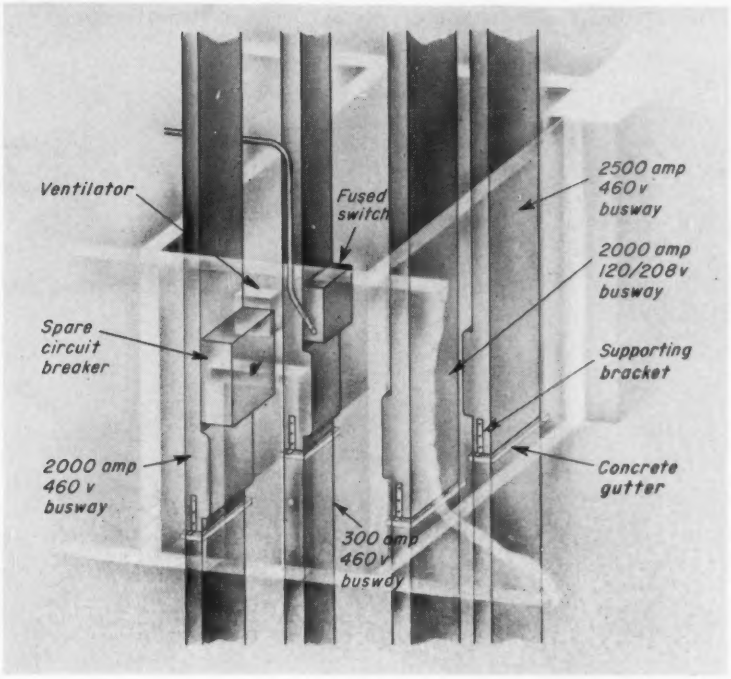
DRY TRANSFORMERS normally operate without fans; use them if over-heating



SWITCH, TRANSFORMER ROOM in the basement is well lighted, air conditioned



spurs original solutions to power distribution problems



TYPICAL CLOSET built in the unused elevator shaft. Spare circuit breakers or fused switches are provided on floors where additional power demands are expected. Wire in thinwall conduit carries electricity to the distribution panels

mounted above the horizontal busways on the basement ceiling to protect them from dripping water, and in such a manner as not to interfere with the circulation of cooling air. The aluminum bus bars are silver plated and bolted joints are on each floor. An expansion joint is provided in each riser.

Low-impedance busways were selected principally because they take up appreciably less space than alternative methods—cable in conduit, or armored cable in racks. We believe this is the largest installation of busway in an existing commercial building. Problems had to be licked as we went along as there was little precedent and experience to go by. The Schwerin Air Conditioning Corporation was in charge of the job. Mr Allan Rogers, electrical engineer employed by Schwerin, designed the distribution system, and the Hittner Electric Company installed it.

Power is purchased at 208 volts, the utility's network voltage, and is stepped up to 460 volts for distribution to the power loads. Dry transformers, two at 1500 kva, one at 400 kva are located in switch and transformer room in the basement. This room is air conditioned and kept at 75 F. Cooling fans on transformers come on automatically if loading heats up coils. If heat continues to climb, an alarm rings. A spare 1500-kva transformer is handy should emergency replacement become necessary. Provision is made in the room for an additional transformer and switchgear should future load require it.

Two of incoming services are protected by 4000-amp breakers. Third service is split, part supplying a stepup transformer, part feeding a 120/208-volt 4-wire riser. Each branch is protected by a circuit breaker. Load side of each transformer is protected with current-limiting fuses in conjunction with disconnect switches.

Four risers come up from the basement. One of these (200 amp, 460 volts, 3-phase, 3-wire) supplies power between the 4th and 16th floors. Another riser (2500 amp, 460 volts, 3-phase, 3-wire) supplies power from the 16th to the 34th floors. A third (600 amp, 460 volts, 3-phase, 3-wire) takes care of power loads on first three floors. Fourth riser is 2500 amp, 120/208 volts, 3-phase, 4-wire. It's intended for lighting, business machines, heaters, etc, from basement to 34th floor. Part of existing load, about 1200 amp, was transferred to this new bus.

Air circuit breakers, molded-case breaker panels and cable tap boxes, adapted for easy connection to the busway, are used to take power from the four risers. Distribution from riser closets on each floor is with wire and cable in thinwall conduit. Circuit-breaker panels are mounted adjacent to air-conditioning units and other convenient locations to give maximum protection. Compressor and blower motors and cooling tower pumps operate on 460 volts. Controls are either 120 or 208 volts, including damper control motors. Each control circuit is fused.

By R G ELMENDORF,* *Majac, Inc*

FURNACE WALL TUBES play an important part in control of proportional heat absorption in modern units. Note soot-blower openings and their cleaning patterns

No longer a little attended gadget, todays soot blower is an important part of total plant investment. This timely discussion points up importance of . . .

Soot blowing

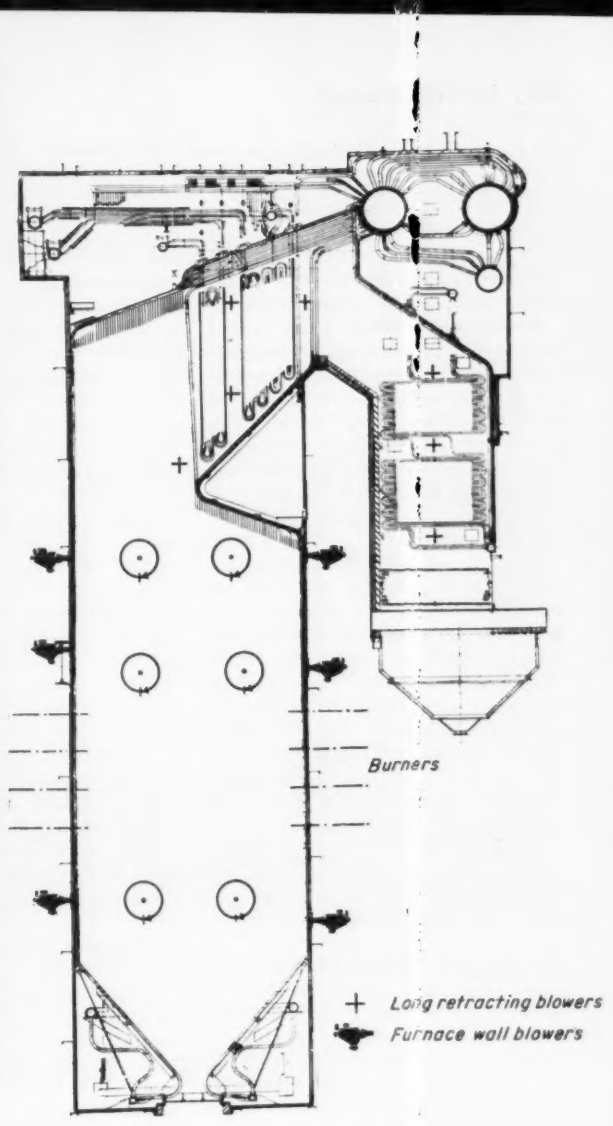
► SOOT BLOWING is becoming an increasingly important and critical part of today's power plant operation. This is particularly true in the electric utility industry which has experienced an almost phenomenal growth in the last ten years. Today's soot blower is an entirely different animal from the little-attended gadget formerly buried somewhere in the rear passes of boilers, with questionable value to the average boiler operator.

The modern blower installation may cost up to 2% of the total plant investment, use up to 1% of boiler capacity for blowing, and require more than 10% of total plant maintenance for repair. These eye-opening figures point up both the soot blower's widespread utilization and the severity of problems relative to its application and its use.

Why use soot blowers? Generally speaking, ash is an important constituent in most of today's fuels. In coal or residual-oil-fired steam generators, quantities of ash from the combustion process build up on heating surfaces. This accumulation should be removed to minimize flue-gas temperature losses, eliminate plugging and control proportional heat absorption between various parts of the unit. To date, soot blowing is the only success-

* Formerly with the Mechanical Engineering Division of the Philadelphia Electric Company

BLOWER ALIGNMENT is important. Welded repair *above* was necessary because poorly aligned element let steam "cut" tube



MORE BLOWERS are needed as boiler size increases; fuel-quality trend indicates increase in fireside deposit problems

to keep modern boilers on the line

ful general method of dislodging ash deposits.

Why can't we burn better fuels that'll produce less troublesome or no ash deposits at all? This is a question that's often asked and extensively discussed, particularly when a new fuel—such as nuclear fission—comes along.

Power plant people would love to use a foolproof heat source because cleaner fuels would not only solve a lot of raw-fuel and ash-handling problems, but also many involving air-pollution control. However, cost and availability of these fuels must be stacked against ultimate cost to the consumer of the electricity generated.

Fuel quality today certainly isn't improving and in the next few decades will continue to drop off as fast as ways are found to handle and burn the cheaper grades. Much of the recent increase in soot-blower use is due to the higher ash content of today's fuels. Added to this is the presence in these fuels of certain compounds and impurities which affect the tenacity and hardness of deposits on heat-transfer surfaces.

On the other hand, advance in power plant steam conditions today is tremendous as compared to those in practice a few years ago. Units operating at 1800 psi, 1000 F are common; a large Eastern utility will soon have a unit with throttle conditions of 5000

psi, 1200 F, with double-reheat. These increasing steam conditions will have a substantial effect on the character and extent of ash deposits and the resulting soot-blowing requirements.

Deposit accumulation in the typical modern high-pressure high-temperature unit proceeds generally as follows: In the furnace, the ash sticks or plasters itself as softened "slag" to the walls. This slagging action may move along with the gas stream into the convection sections, and as far back in the unit as gas temperatures stay above ash-softening temperatures.

Around cool openings in these hot zones, slag may harden and build up into large masses, such as burner "eyebrows." Or, where tubes form slag-catching pockets, there's apt to be "birds' nests." Beyond the hot zones the ash begins to cool, has a less agglomerate nature. In the rear passes it has the flaky, soft characteristics of soot and is easily blown from the tubes, hence the original name of the equipment—soot blowers.

In the cold-end equipment (air heater, dust collector, etc) where gas temperatures fall close to or below the dew point, the deposits tend to set up and become very corrosive. (Some units will deviate from this basic pattern, of course, depending on the fuel characteristics and operating techniques).

Susceptibility to these fireside deposits varies widely with boiler design and determines whether soot blowing is a normal justified routine or a severe operating problem.

Ash accumulation generally should be held low enough to keep flue-gas temperatures at an efficient level. (Historically, arguments for soot blowers were always based on efficiency considerations). However, maximum permissible accumulation limits in today's furnace and convection passes are determined by other more critical factors.

Lane plugging, with resultant increase in draft loss and unbalanced gas flow, limits maximum slagging in the convection passes. Local overheating of tubes occurs sometimes, particularly in units with narrow lane spacing in the hotter zones. In the cooler convection zones, plugging may occur by trapping pieces of slag blown from the wider-tube-space preceding sections. Heavy accumulations may also drop steam temperatures or upset superheat-reheat balance.

In conventional furnaces, steam temperature primarily limits slagging. The amount of heat absorbed in boiling each pound of water must proportionally balance that absorbed in superheating and reheating the steam. With excessive slag, the waterwalls absorb less of each heat unit for boiling, and more goes into the superheater and reheater. This boosts steam temperatures beyond control limits and makes it necessary to either drop load, or get rid of the slag by soot blowing or hand lancing.

Extent of allowable slag build-up in the furnace is also limited by the bottom-ash system's ability to handle large masses of slag without bridging across the hoppers or choking crushers and transport lines.

Proportional heat absorption between the waterwalls and the superheater-reheater has been changing substantially in recent years to aggravate the severity of furnace slagging. Table 1, below, shows approximately the changing proportion of total heat absorbed by superheater-reheater sections, waterwalls and economizer due to higher steam conditions and the addition of reheat. The figures represent relative Btu gain for 1 lb of water in each heating stage from the economizer until it leaves the boiler (based on enthalpies at the throttle and reheat pressures, with reheater flows assumed to be 80% of main steam.)

This table shows that in modern boiler design, as steam pressures and temperatures go higher, a constantly decreasing percentage of heat released can be absorbed by the waterwalls and more and more must be absorbed by the superheater, reheater and economizer. Until recently, this meant progressively smaller furnaces and higher furnace temperatures. Thus, conditions tending to promote heavy slagging and an acute soot-blowing problem have been built right into the unit.

Certain opportunities exist for improving boiler design to reduce the extent and effect of slag and ash build-ups. Most boiler companies are familiar with the problem to some extent and are experimenting with new designs.

Accepted solution to plugging in the convection passes lies in using wider lanes. Most new central-station boilers use an 18 to 24-in. spacing in the leading pendant sections, with progressively smaller spacing in lower temperature zones. About a 1-in. clear opening is allowed in the economizer.

Several approaches can be made in the furnace: (1) larger furnaces (2) more soot blowers (3) radiant superheaters and reheaters (4) improved firing.

Furnace volume increase method is widely used today. It's designed to cut heat release well below 20,000 Btu per cu ft per hr for a dry-bottom boiler. It's based on the assumption that the furnace must slag normally enough to put sufficient heat into the superheater-reheater passes. The method works well, though designed steam temperatures tend to be low and are sometimes below the superheat control range when the unit goes in service. Normal slag build-up tends to correct this and the method allows a greater slagging range.

Soot blowers must be installed and used, but their use is more periodic and intent is to control slagging rather than eliminate it. Difficulty with this method may show up in the future when changing load patterns tend to shift the base load to newer, more efficient units. Slag's reluctance to stick to furnace walls at low loads, plus the natural decrease of superheater-reheater relative absorption at these loads, may exceed the range of conventional superheat controls, such as gas recirculating and burner tilt. Too, lower furnace temperatures and lessened gas turbulence in the larger furnace usually means less efficient combustion.

(*Continued on page* 220)

Table 1: The changing Btu demand

Steam conditions (Throttle	Waterwalls	Superheater and reheater	Economizer
900 psi, 900 F	64%	24%	12%
1300 psi, 900 F	65%	27%	8%
1300 psi, 950 F	62%	29%	9%
1800 psi, 1000 F/1000 F	54%	43%	3%
2400 psi, 1050 F/1000 F	47%	48%	5%
5000 psi, 1200 F/1050 F/1050 F	41%	52%	7%

- **With a 5000-kva demand, primary selective circuitry was installed using 4.16 kv to secondary subs with tie lines on secondary side**
- **Power-to-grow provided through 22.9-kv double feeds from utility, each sized to carry full building load**
- **Boiler, incinerator and emergency diesel-generator placed in underground concrete vault**

Power services at Connecticut General's new home are prime example of . . .

Modern planning for easy expansion

► FUTURE is spelled out all over this new home for Connecticut General Life Insurance Co. Architect-builder-owner team mixed the eye appeal of Japanese gardens with the purely functional design of hydraulically assisted front doors, and the last word in decor with the most recent thinking on building air conditioning. Located in Bloomfield, Connecticut, on the outskirts of Hartford, the building is a true example of modern planning for easy expansion in coming years.

Electrical power comes to the building site over two 22.9-kv underground lines, either of which can carry all of the present load. Duplicate 5000-kva transformers, each capable of handling about 75% of the building's total connected load, step voltage down to 4.16 kv at the primary substation. When load warrants, fan cooling can be added to increase transformer capacity to 6250 kva. Service continuity is further assured by a tie breaker between the transformer secondaries.

Fed through a primary selective radial system, eight substations in the building basement trim the 4.16 kv down to 277/480. This dual-voltage 3-phase supply handles fluorescent lighting and air conditioning. Further reliability comes from the ties installed between secondary subs. Main and tie breakers are mechanically interlocked for protection, as you would expect.

Dry-type transformers, spotted near the subs, take the 480 and cut it to 120/208 for incandescent lighting and office machines. Machines are fed through underfloor ducts.

Emergency power comes from a 750-kva standby diesel-generator. Should both incoming lines fail, the fire pump, one well-pump, essential heating and emergency lighting would be swung over to the standby source. To avoid feeding back into the master sub, main breaker of the manually started diesel-generator is interlocked mechanically with the primary circuit breakers. Physically located in a 72-ft wide, 108-ft long, 26-ft high concrete vault, buried beneath a 4-ft ground cover adjacent to the building, the locomotive diesel unit stands ready for fast takeover in an emergency.

General office lighting filters down through an open-baffle arrangement. Although there are several ceiling types, the open-baffle design developed for the project is most widely used. Serving in true multipurpose fashion, the open baffle corrects acoustics, anchors partition supports and helps conceal sprinkler heads, air diffusers, fluorescent tubes and loudspeakers. No further light-diffusing medium is used. However, special ballasts reduce fluorescent brightness to one-third normal.

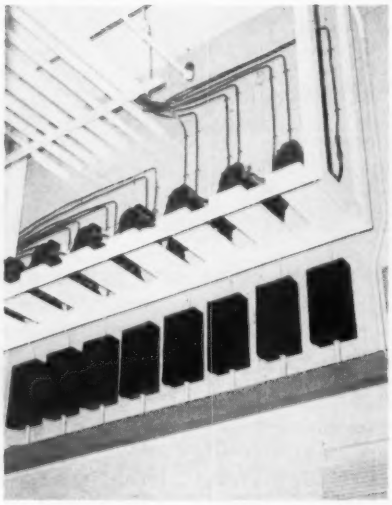
Vertical transportation depends on two operatorless elevators, four pairs of escalators, two combination passenger-freight elevators. All escalators run up during morning peak, down during evening rush. Right now traffic flow is steady and orderly at all times and, according to the building plan-

HERE'S WHAT THE VISITOR SEES

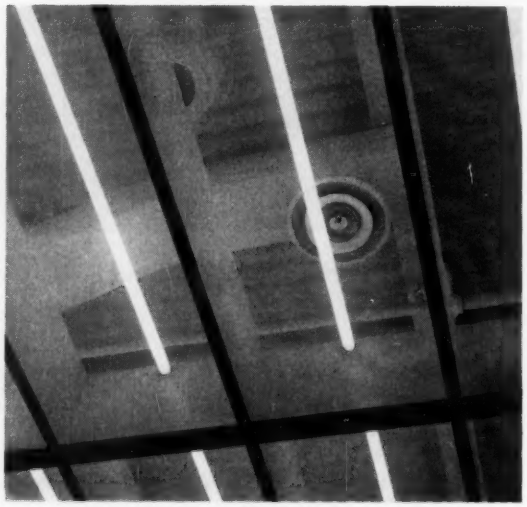
Little effort is needed to move building's front entrance doors

Well-lighted corridors and general work areas have a pleasing no-glare effect

HERE'S A BEHIND-THE-SCENES PICTURE



Electrically controlled pumps, part of hydraulic system, are answer



Open-baffle ceiling houses 72-in. T-12 lamps, air ducts, sprinklers, PA speaker

ners, should remain so even when the building reaches maximum population.

Concrete vault, housing and standby generator also serve for incinerator and boiler. At present there are two 200-psi boilers, each of which can generate 27,500 lb of saturated steam per hr. In winter No. 6 oil is the fuel while natural gas from the main New England trunk line serves during summer months. Provision has been made for coal-stoker equipment. The room has been provided for coal storage and one more boiler.

Fuel oil is stored in a pair of underground cylindrical tanks. Tanks can handle 120,000 gallons collectively, enough fuel for about two weeks' operation at maximum load. Steam is normally used to raise oil temperature to 220 F for atomizing while electric heating does the job on startup. The oil pumps, sized to about twice the maximum-burning rate, maintain a flow of warmed excess oil back to the tanks. This keeps stored supply up to the 120 F pumping temperature.

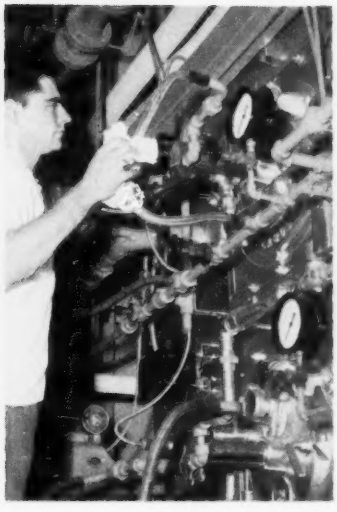
Vault's nerve center is a panel containing necessary instruments plus motor and combustion controls. In addition, a set of safety controls is mounted near each boiler. Air, for combustion and ventilation, enters and leaves through grade-level openings. Ventilating-air temperature is regulated by two heating and air-conditioning units.

Well water, drawn on the site, handles almost one-third of building's 2350-ton refrigeration load. The 3000-gpm 57-F flow precools the fresh air in all air-conditioning units, condenses turbine exhaust and refrigerant in the two 800-ton centrifugal refrigeration machines. Water then empties into an artificial lake adjoining building and serves as fire-fighting reserve. Should well-water source fail, cooling towers can be substituted. Provision has also been made for further refrigeration.

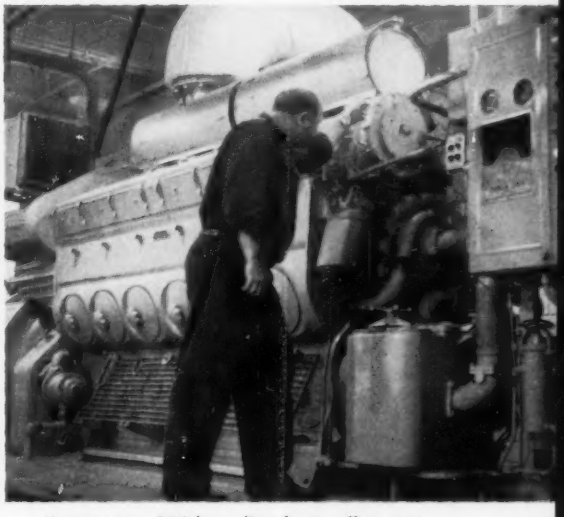
Hot water for heating, or refrigerated water for cooling, flows through 1434

Comfortable interiors, winter and summer, bespeak top planning behind the all-year air conditioning

Primary sub encloses two 5000-kva 22.9-kv transformers within shrubbed area



Heating-plant operation, *left*, is influenced by teletyped weather from 100 building locations, *right*



Emergency 750-kw diesel standby generator in boiler room backs up main sub

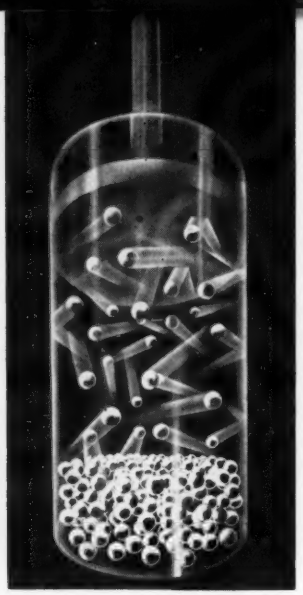
induction-type air-conditioning units. Ceiling ducts and perforated vertical baffles supplement these in interior areas. Sprayed-coil dehumidifiers give year-round humidity control. Part of the water in all closed systems is intermittently diverted through a chemical feed tank for treatment.

Entire system is so flexible that the shady side of building can be heated while the sunny side is being cooled. Each unit is individually regulated and all can be operated from engineer's master control room. Equipment in this room includes . . . a teletype to report weather conditions, a recording-strip thermometer to check performance of refrigeration system, recording flowmeters to monitor well-water and steam systems, start and stop switches for all fan systems, emergency stop switches for the refrigeration plant and all pumps, 108 temperature indicators for the building. In addition, there is a master control that can shut down all fan systems connected to the outdoors, thus sealing against atomic fallout.

Power-to-grow features extend far beyond the electrical system. The general project facilities include allowance for a future 50% expansion of the structure to include power plant, stores, bank, offices, theatre, bowling alleys, cafeteria, printing plant, refrigeration plant and hospital. The site includes parking fields, garage, ponds, picnic grounds and tennis courts.

PTG electrically comes in at several points. Example: two sets of 3-500 mcm feeders carrying power to the primary substation, each feeder sized to carry the building-demand load. Also, main transformers have provision for fan cooling should future load demand the added capacity. Another PTG feature: two spare 4-in. conduits per service (total of 4) run between the primary substation and the building. Total connected load is 6600 kva with the demand figured at 5000 kva based on 75% demand factor.

THERMO REFRESHER NO. 13



Variety is not only the spice of life but of thermodynamics too. With a relatively few types of processes we can do many things: create mechanical power, refrigerate areas, transmit energy, etc. Here are examples of using different processes and a regenerator so you can . . .

Choose your own heat engine

By B G A SKROTZKI, *Associate Editor*

► WE HAVE paid much attention to the theoretical Carnot cycle and learned how it can convert heat to mechanical work, how it can cool areas below the surrounding natural temperatures, and how it can use low-level energy to heat an area. The Carnot engine is relatively simple and can operate at the highest efficiency—but no one has tried to build one.

There are several reasons: while simple in basic needs it's mechanically difficult to bring the hot source and cold receiver to the cylinder head in turn; each cycle produces only a small amount of net mechanical work. The net area on the P-V diagram in Fig. 1 shows the small net work realized for an expansion ratio of 6.3; this would make the engine very heavy on a pound per hp basis.

Stirling cycle. Realizing this weight disadvantage Robert Stirling, in 1827, set about designing a more practical engine. We won't study the design of the actual engine (now obsolete) but only the series of processes it attempted to use. As you might anticipate the engine fell far short of the ideal reversible cycle it used for a model; but it worked, ran at good efficiency and developed a fair output per cycle.

With the poor material available in the early days the heat transfer surfaces at the furnace heat source corroded and ultimately failed. But the engine had only about half the weight per hp that a theoretical Carnot engine would need. Stirling engines served practical uses for a time.

Fig. 1 compares the Carnot, Stirling and Ericsson cycles; we'll discuss the latter later. The P-V and T-S diagrams show that for the same source and receiver temperatures, and total piston displacements, the Stirling cycle produced more than double the output of the Carnot cycle.

We already know the Carnot cycle, but Fig. 1 lists all the steps needed to make it work; application of source during heat input, application of insulator during constant-entropy expansion, application of receiver during heat rejection, application of insulator during constant-entropy compression.

In the Stirling cycle we also absorb heat energy from the source during a constant-T expansion, ab, but for the full piston stroke. But now we have a cylinder full of hot gas at state b. We must get rid of some of this internal energy before we can return the piston to the head end. If we applied the receiver at this time, we would lose a lot of the energy by irreversible heat transfer through the temperature difference T_s–T_r.

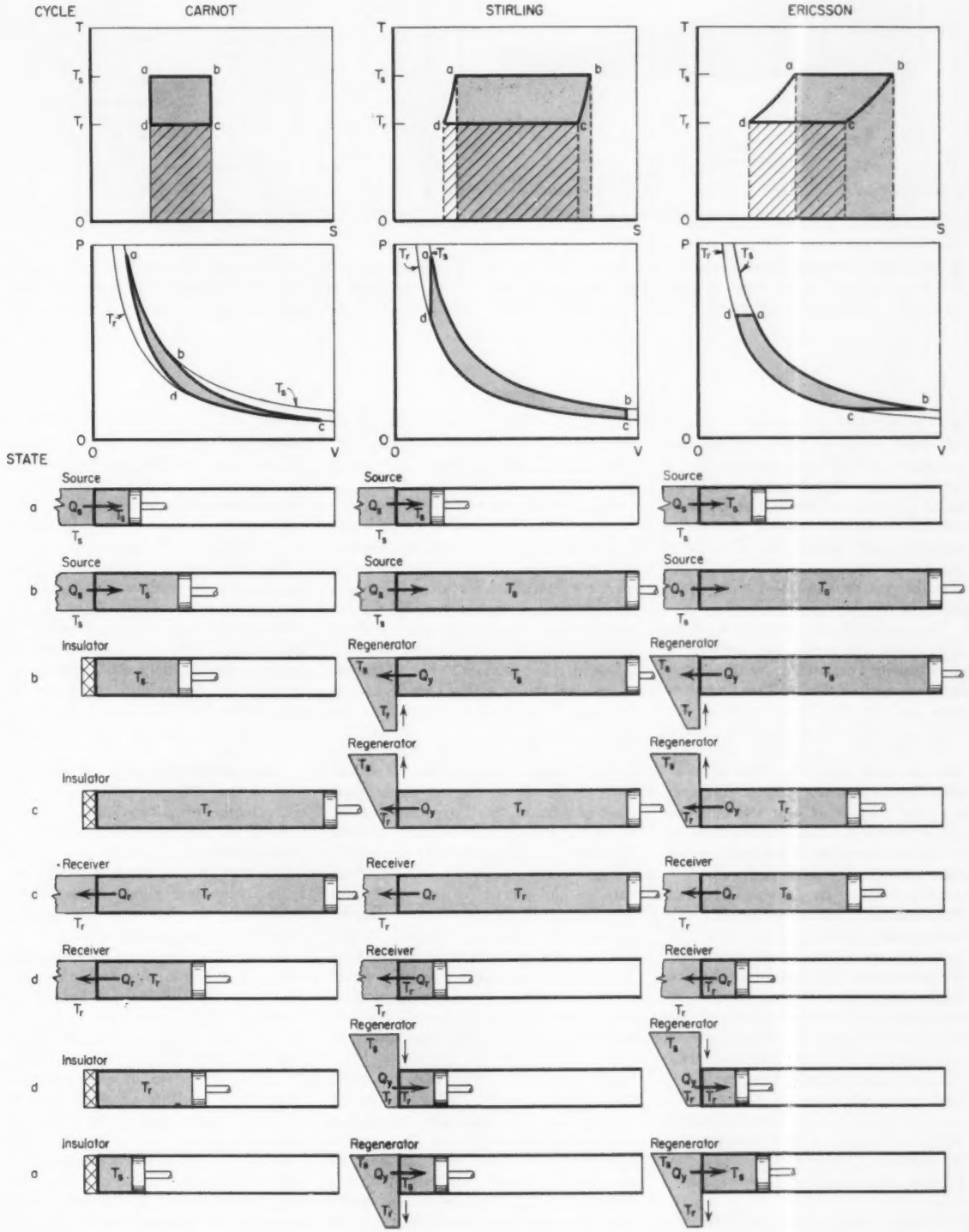
To avoid this, Stirling got the brilliant idea of removing some of this energy *reversibly* by using a regenerator. This unit absorbs heat Q_y and stores it for future use. Fig. 2 outlines the practical form of a regenerator. It consists of refractory brickwork, or metal mesh, or small tubes, through which the hot gas flows. As the hot gas enters from the left at T_s it gives up heat energy to the regenerator material and drops in temperature as it advances. By the time the gas leaves at the right end it has cooled to a lower temperature, T_r.

When the gas flow is reversed, it reenters the regenerator at the right and reabsorbs the energy as heat and rises in temperature as it progresses through the unit. For the ideal reversible condition it would leave the regenerator with the same temperature it originally entered, T_s. The center graph, Fig. 2*a*, shows the reversible temperature changes in the regenerator for either direction of gas flow. As a matter of interest, Fig. 2*b*, shows roughly how actual gas and regenerator temperatures would behave.

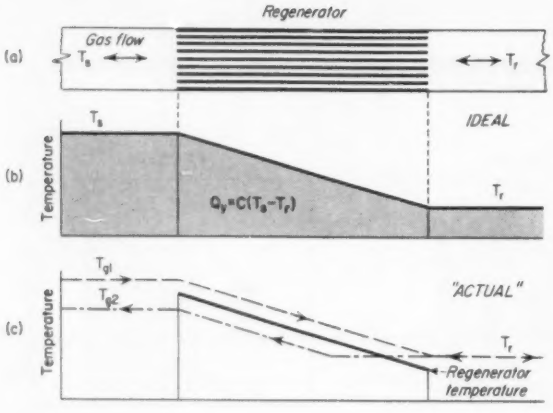
We indicate the regenerator in Fig. 1, by the wedge-shaped figure. It is moved over the conducting face of the cylinder to absorb heat Q_y reversibly while it lowers the gas temperature from T_s to T_r during the process bc. Gas volume stays constant during this process, and the pressure drops.

We then bring the cylinder head in contact with the receiver and reject unavailable energy Q_r for the full pis-

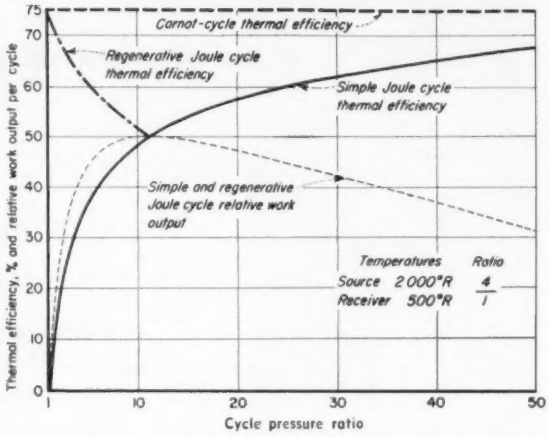
Cycle outputs depend on piston displacement, temperature, processes



1 These three cycles work between same temperature levels and with the same piston displacement. Though they all perform with the same thermal efficiency (for reversible processes) they produce different net work outputs per cycle



2 Hot gas entering regenerator at left cools down as it gives up and stores heat in unit. Cool gas re-entering from right warms up as it reabsorbs the stored heat energy



3 Joule cycle work output varies with pressure ratio, reaches a maximum at about 11. Regenerative cycle has higher efficiency in lower pressure-ratio range than simple cycle

ton stroke during constant-T process cd. Next, at d we place the low-temperature end of the regenerator in contact with the cylinder head and move it down so stored heat Q_y is reversibly reinjected into the gas during the constant-V process da. This raises the gas temperature from T_r to T_s and also the gas pressure and the cycle is ready to repeat.

The enclosed gray area $abcd$ on the P-V graph measures the amount of mechanical work done by the cycle. It is more than double the amount of work done by the Carnot cycle, at left.

In the T-S graph for the Stirling cycle the gray area under ab measures the heat input, Q_s. The area under the constant-V process bc measures the amount of heat stored in the regenerator, Q_y. The hatched area under cd measures the unavailable energy rejected, Q_r. The area under the constant-V process da measures the heat Q_y reinjected into the gas by the regenerator.

Total heat injected into the gas is the area under dab, total heat rejected by the gas is the area under bcd, so the net area $abcd$ measures the net heat input to the cycle. By the simple energy equation we know this heat equals the net work output of the cycle.

Thermal efficiency of the cycle is equal to $(Q_s - Q_r)/Q_s$. Since both heats are transferred reversibly at constant-T, the efficiency then also equals $(T_s - T_r)/T_s$, the same as the Carnot cycle efficiency.

Ericsson cycle. About the middle of the 19th century, John Ericsson designed a hot- air engine to also use a regenerator. Cycle-wise it differed from the Stirling engine in making the regenerative heat transfers during constant-P processes instead of during constant-V processes.

Fig. 1 shows the T-S and P-V charts for the reversible Ericsson cycle and how they compare with the Carnot and Stirling cycles. Thermal efficiencies of all three are equal for identical source and receiver temperatures. Work output per cycle for the Ericsson is about 60% greater than the Carnot, but only 70% of the Stirling. The Ericsson cycle has the practical advantage of having a lower peak pressure than the other two, in Fig. 1—it's about one-third less. This helps in requiring a lighter engine construction. Ericsson built thousands of his hot-air engines, most of them of small capacity and not using the regenerative feature. But today they are only historical curiosities.

Regenerative heating. Let's make sure we understand the basic duty and advantage of the regenerator in the Stirling and Ericsson cycles. It primarily retains a certain amount of internal energy within the engine cycle by heat transfer during certain processes. This is done to lower and raise gas temperatures reversibly. In this way we avoid degrading high-grade available energy into low-grade unavailable energy by allowing heat to be transferred irreversibly through a temperature drop.

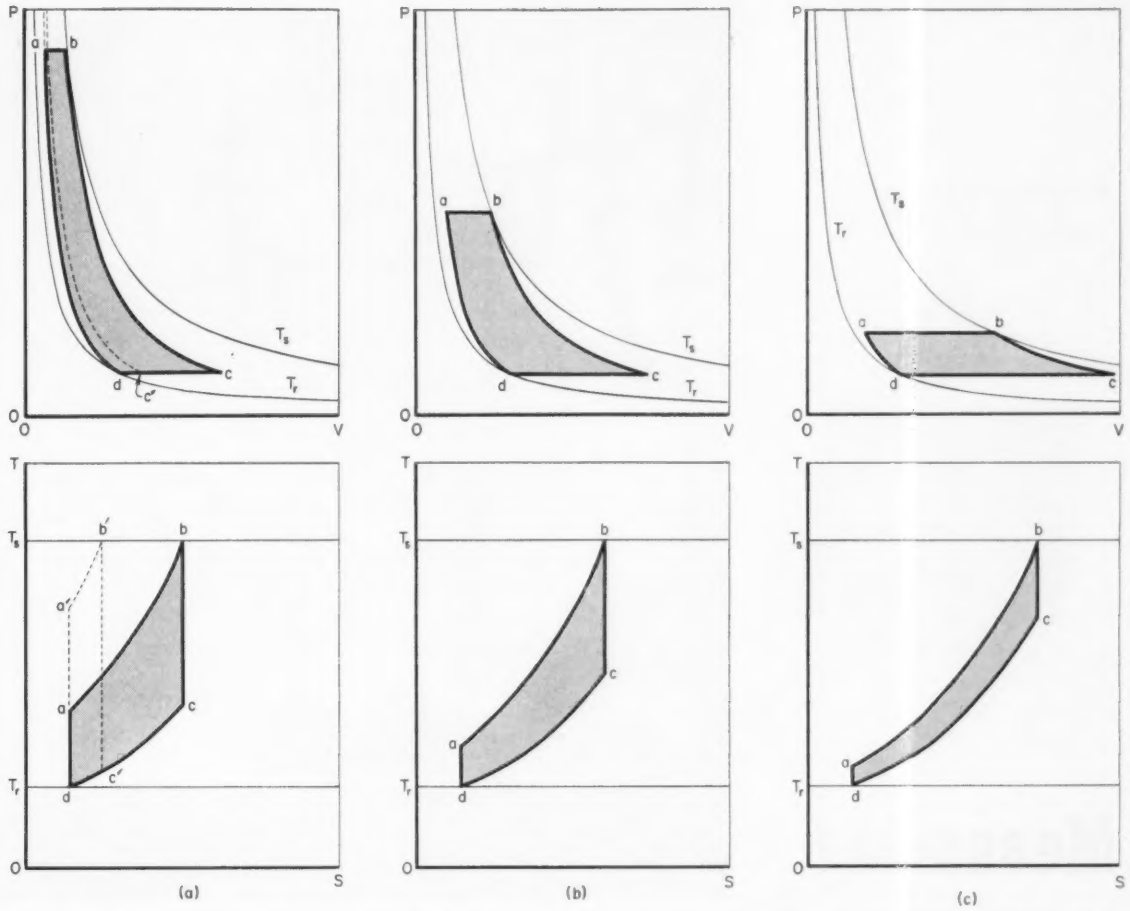
As we well know, heat can only be transferred actually by a temperature difference; so the practical advantage lies in *reducing* the amount of temperature loss in transferred heat energy. For instance, in Fig. 2*c*, instead of letting all of the energy Q_y in the gas at the end of the working stroke be degraded from $T_{g1} = T_s$ to T_r, we can recover part of it at a lower temperature T_{g2} during the reverse flow. All actual regenerative heating processes only partly realize the theoretical advantages.

The regenerative principle is used in modern steam-electric plants and some gas-turbine plants. These plants, however, do not have a storage-type regenerator. Instead, heat exchangers keep a certain amount of internal energy circulating within the plant energy cycle. The basic aim is the same: to reduce the amount of irreversible heat transfer.

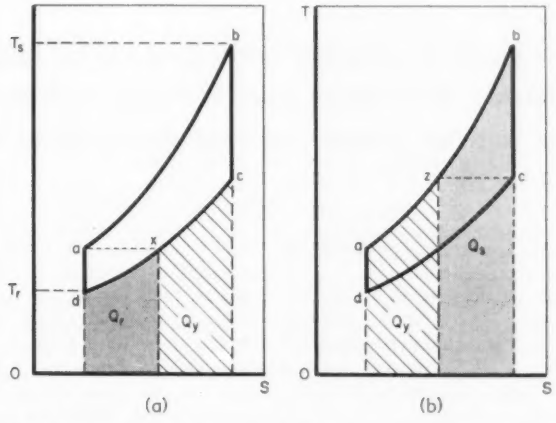
Joule or Brayton cycle. In the latter part of the 19th century, two men independently proposed engine designs to work on the cycle shown in Fig. 4. James Joule of England and George Brayton of Boston, Mass. intended this cycle for reciprocating engines but it actually is the basis for the modern simple-cycle gas-turbine plant.

Again, since the original engine designs are obsolete, let's study this cycle assuming that a fixed amount of gas (working fluid) is trapped in a cylinder behind a piston as in the Carnot engine of Fig. 1. In Fig. 4 we have the cycle for three different pressure ratios (P_a/P_d) but all work between the same source and receiver temperatures.

In all of them we have the gas at its highest pressure in state a. We then apply the source at temperature T_s and heat the gas at constant pressure until the gas temperature rises to T_s at state b. Notice that this process is extrenally thermally irreversible, since



4 Joule (or Brayton) cycle performance depends on both temperature and pressure ratio. Because it does not transfer heat at constant temperature, the thermal efficiency of the cycle is lower than the Carnot for same temperature limits



5 Regenerative Joule cycle lessens the loss from irreversible heat transfer to boost the overall thermal efficiency

the heat added, Q_s, enters the gas through a temperature drop. We may, however, regard the constant-pressure heating process as internally reversible. We use the temperature drop for practical advantage, realizing that the thermal efficiency suffers accordingly.

At state *b* we remove the source and put on the insulating cap over the cylinder head. We then let the gas expand at constant-*S* to the lower pressure of the cycle at state *c*. This converts some of the internal energy of the gas to work output at the piston.

Next, we remove the insulating cap and apply the receiver at temperature T_r. We find the gas temperature higher than the receiver temperature so the energy Q_r rejected by the gas to the receiver drops irreversibly through a large temperature drop. Again we do this for practical advantage, despite the adverse effect on thermal efficiency. We transfer Q_r during the constant-pressure compression process *cd*, until the gas temperature drops to T_r.

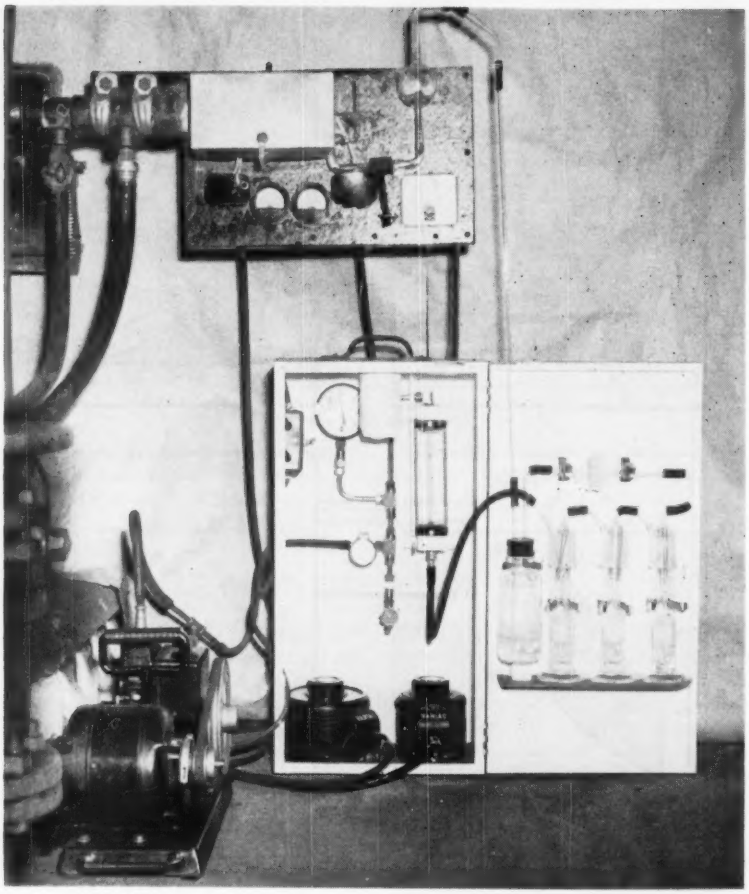
At state *d* we remove the receiver and again apply the insulating cap. Then compressing the gas at constant-*S* we raise the gas temperature to some intermediate level at state *a*. From here we repeat the cycle.

Fig. 4 shows the P-V and T-S dia-

(*Continued on page* 218)

By R E MATTY and E K DIEHL,
The Babcock & Wilcox Company
Research Center

Measuring flue-gas SO_2 and SO_3 . . .



1 Analyzer set up in field has bubbler and gas temperature controls connected to sampling tube outlet, *upper left*. Vacuum pump *lower left* controls gas flow

with this improved apparatus makes it easy to test and analyze boiler furnace performance with laboratory accuracy. Here is how the analyzer is built and used during boiler test runs

► NEED FOR reliable methods of finding the concentration of SO_2 and SO_3 in boiler flue gas has become increasingly important. Tendency of some of the SO_2 to oxidize to SO_3 during sampling has made most methods of doubtful value. The following conditions must be met to insure accurate sampling and analysis of SO_2 and SO_3 in flue gas from boilers:

(1) Flue gas must be kept above the dew point before entering the gas absorber bottles to avoid loss of SO_2 and SO_3 by condensation.

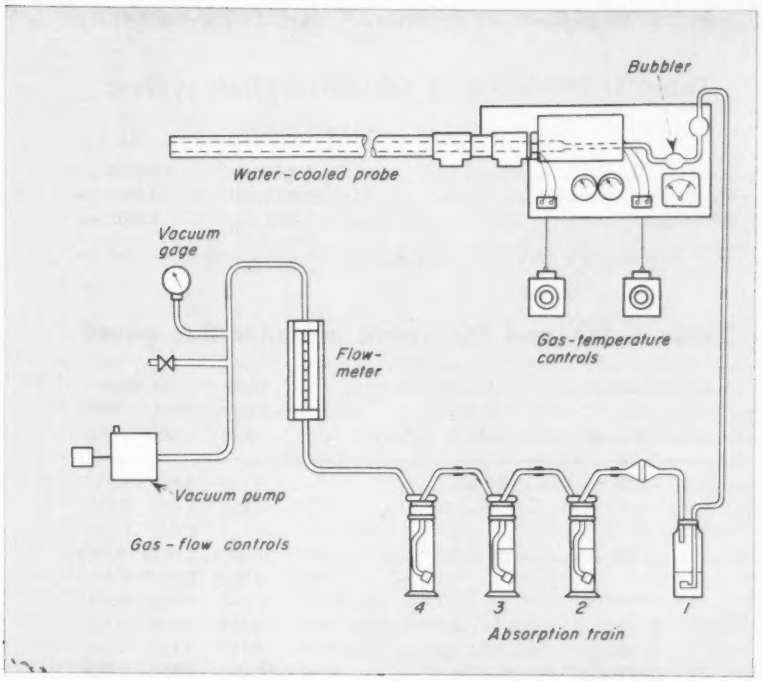
(2) Gas entering the sampler must immediately contact an inhibitor to stop the oxidation of SO_2 to SO_3. This oxidation tends to accelerate at temperatures lower than the dew point.

(3) Flyash particles must be removed from the gas sample at temperatures that have minimum catalytic effect and where there's little chance for the oxides of sulfur to react with or condense on these particles.

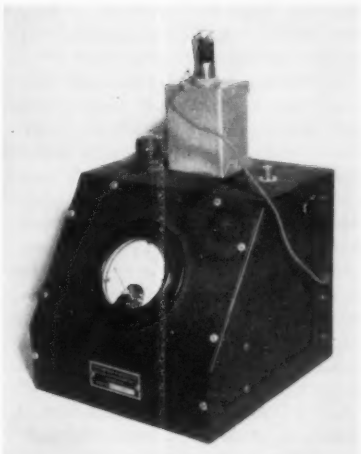
References 1 and 2 at the end of this article describe a method for SO_2 and SO_3 determination under controlled conditions that minimizes the oxidation of SO_2 during sampling. We adapted this method. Alterations in equipment and analysis make it more suitable for our purposes.

Equipment layout, Fig. 1 and 2, uses a sampling tube 6-ft long with an internal diameter of ½ in. made of quartz tube wound with nichrome-resistance wire, insulated and lagged, and enclosed in a water-cooled jacket. The electric heating unit helps maintain the sample at 600 to 700 F. This range is well above the dew point of SO_3 and below the temperature at which the SO_3 would be oxidized by the catalytic effect of quartz.

The water-cooled jacket allows using the tube in high-temperature zones of the boiler. A filter in the quartz tube, about 2 in. from the inlet, removes flyash from the entering gas sample. The filter consists of a plug of Kaolin



2 Gas from boiler enters analyzer circuit through water-cooled probe, passes through bubbler, absorption train, flowmeter, discharges through vacuum pump



3 Turbidimeter makes fast analysis of solutions carrying absorbed sulfur

wool held in place by a nichrome-wire basket. Since filter and tube are both warmed by the electric heater the sulfur oxides do not condense.

When sampling gas in high-temperature zones with oil firing, the Kaolin wool is placed over the end of the quartz tube. This keeps it at flue-gas temperature.

A U-shaped bubbler, holding 80% isopropyl alcohol, connects to the outlet end of the sampling tube. Saturating the flue gas with the alcohol in this bubbler inhibits further oxidation of SO_2 to SO_3. A resistance heater raises the inlet side-arm of the bubbler to about 400 F to prevent any condensation of the flue gas prior to contacting the alcohol.

The absorption train connects to the probe bubbler with glass tubing. The first bottle, *1*, contains additional 80% isopropyl alcohol for completing the absorption of SO_3. A G-4 fritted glass filter follows this bottle to trap any sulfuric acid mist that might escape from the absorption bottle.

Two absorption bottles, *2* and *3*, follow the filter and contain hydrogen peroxide to absorb SO_2. The dry bottle, *4*, protects the flowmeter from possible mechanical carryover of the peroxide solution. We prefer this method of SO_2 absorption to the use of an iodine solution which requires maintaining standard iodine and thiosulfate solutions on the job. Usually a rough calculation of the amount of sulfur to be absorbed can be made prior to a test, so we can eliminate a "saturation indicator" needed with an iodine solution.

The vacuum pump, Fig. 2, draws the gas through the train. The flowmeter following the last absorption bottle measures the gas flow. A by-pass and needle valve controls the gas flow.

Analytical method. To find results quickly with a minimum amount of equipment we devised a turbidimetric method of measuring sulfate and total sulfate. We built a portable turbidimeter, Fig. 3, especially for this purpose.

Light passes down through a Nessler tube containing the solution to a photoelectric cell at the bottom of the tube. A microammeter connected to the photo cell measures the degree of obscuration. For best accuracy Nessler tubes should be matched by actual test. This must be done even when using "factory matched" tubes. We find Nessler tubes satisfactorily matched when readings agree within ± 0.1 microampere when they carry the same volume of water.

Reagents used in this method include:

Isopropyl alcohol		CP
Hydrogen peroxide	3%	CP
Barium chloride		CP
Standard H_2SO_4		N/10

Solution A:
- 72% isopropyl alcohol by volume
- 18% water by volume
- 10% concentrated HCl by volume

Solution B:
- 20% $BaCl_2$ solution

For SO_3 concentrations less than 0.001% by volume a 1% $BaCl_2$ solution is recommended for the SO_3 analysis. This greatly increases the sensitivity of the determination.

The test run uses the following solutions:

(1) Place about 25 ml of 80% isopropyl alcohol in the bubbler.

(2) Place 125 ml of 80% isopropyl alcohol in bottle *1*.

(3) Place 50 ml of distilled water and 25 ml of 3% hydrogen peroxide in bottles *2* and *3*.

(4) Additional bottles made up as in (3) above may be added as needed.

(5) Leave bottle *4* dry as a safety trap to protect the flowmeter.

Before attaching the absorption train to the probe turn on the heating unit to warm the tube to proper temperature. This takes from 20 to 30 minutes depending on whether the probe needs water cooling.

When probe reaches operating temperature, attach absorption train to tube and adjust the flow rate until about 1 liter of gas per minute passes through the system. Take time, temperature

and vacuum readings throughout the test, usually of one hour duration.

At end of test do the following:

(1) Rinse the bubbler, filter and bottle *1* with 80% isopropyl alcohol into a 250 ml (or 500 ml) volumetric flask and dilute to volume with 80% isopropyl alcohol. This is sample No. 1 used to determine SO_3 content.

(2) Bottles *2* and *3* (and any additional ones if used) are rinsed with water into a 250 ml (or 500 ml) volumetric flask and diluted with water to volume. This is sample No. 2 used to determine total sulfur.

Measuring SO_3. Place 45 ml of sample No. 1 in a 50-ml Nessler tube. Add 5 ml of solution A and mix well by shaking. High results will be obtained from incomplete mixing. Add 1 ml of solution B and shake well for 30 seconds. Allow the sample to stand for 5 minutes.

Rate of addition of barium-chloride solution must be controlled. The rate used for establishing the calibration curve should be used in all determinations when applying this curve. The curve we use was established for an additional rate of 1 ml in 7.5 seconds. Any excessive deviation from this rate will give high or low readings when using this curve.

The manner of shaking the sample after adding the barium chloride is not critical, but a procedure has been standardized for it. This uses a slow rhythmical shaking with no sharp change in direction with a speed of between 25 and 35 inversions in the 30 seconds.

Prepare the blank from 45 ml of the sample, 5 ml of solution A and 1 ml of distilled water. This method of preparing the blank compensates for any turbidity which the sample solution may have prior to adding $BaCl_2$.

Use the blank to set the microammeter scale at its highest reading. Substitute the sample for the blank and read the microammeter.

Read the SO_3 content directly from a calibration curve made by running a series of solutions to which known quantities of standard H_2SO_4 have been added and treated with the reagents. A standard containing an appropriate amount of N/10 H_2SO_4 solution should be run with every set of determinations. When making standards, the volume of standard sulfuric acid used should be deducted from the amount of water added. This will keep the quantities of water, isopropyl alcohol, hydrochloric acid and barium chloride constant for all standards and samples—a precaution necessary for reliable turbidimetric results.

Measuring total sulfur. Place 5 ml of sample No. 1 and 5 ml of sample No. 2 in a 50-ml Nessler tube. To this add 32 ml of pure isopropyl alcohol and 3 ml of water and repeat the procedure described before. A separate blank using 1 ml of distilled water in place of 1 ml of solution B should be made for this determination. The solution to read in the turbidimeter has been adjusted to contain the same amounts of isopropyl alcohol, hydrochloric acid, water and barium chloride as the solution containing the SO_3 so the same calibration curve can be used in both determinations. If a 1% $BaCl_2$ solution is used for extremely low concentrations of SO_3, a separate curve must be used. The small amount of hydrogen peroxide present was found to have no appreciable effect on the determination. Normal variations of temperature do not appreciably affect the results.

Calculations. The following formulas apply to samples diluted to 250 ml

Table 1: Efficiency of SO_3 absorption system

Test	No. 1	No. 2
Weight of SO_3 added	0.0072 gm	0.0103 gm
Weight of SO_3 recovered	0.0075 gm	0.0101 gm
Difference	0.0003 gm	0.0002 gm

NOTE: These amounts of SO_3 are more than double those normally collected during a test run

Table 2: SO_2 and SO_3 found in boiler flue gases

Sampling location		Superheater	Air heater Inlet	Air heater Outlet
Station	Gas temperature, approx, F	1800	700	300
A	% SO_2 by volume (dry basis)	0.148	0.124	0.114
		0.152	0.129	0.128
			0.133	0.123
	% SO_3 by volume (dry basis)	0.0034	0.0038	0.0033
		0.0039	0.0038	0.0023
			0.0043	0.0032
	% total sulfur gases by volume (average)	0.154	0.133	0.124
	% theoretical total sulfur gases by volume*	0.149	0.139	0.126
	Difference	0.005	0.006	0.002
B	% SO_2 by volume (dry basis)	0.220	0.201	0.193
		0.215	0.205	0.189
	% SO_3 by volume (dry basis)	0.0022	0.0032	0.0020
		0.0025	0.0030	0.0019
	% total sulfur gases by volume (average)	0.218	0.206	0.193
	% theoretical total sulfur gases by volume*	0.217	0.199	0.190
	Difference	0.001	0.007	0.003
C	% SO_2 by volume (dry basis)	0.100	0.087	0.087
		0.096	0.086	0.089
				0.089
	% SO_3 by volume (dry basis)	0.0028	0.0031	0.0020
		0.0029	0.0033	0.0014
				0.0017
	% total sufur gases by volume (average)	0.100	0.090	0.090
	% theoretical total sulfur gases by volume*	0.091	0.085	0.086
	Difference	0.009	0.005	0.004

* Calculated from fuel analysis and combustion data

volume, for 500-ml dilutions double the answers:

(1) To find total grams SO_3, take gms SO_3 as found by turbidimeter and calibration curve, multiply by 5.56 to get weight of SO_3 in total gas sample.

(2) To find sulfur, take gms SO_3 as found by turbidimeter and calibration curve, multiply by 50 to obtain total sulfur SO_3 in gas sample.

(3) To find total SO_2 in sample, take weight found in Step 2, subtract the weight found in Step 3, multiply the difference by 0.8.

(4) From the volume of gas sampled and the weights of SO_2 and SO_3 calculate the percentage of these constituents in the flue gas.

Discussion. The sampling probe described in reference 1 had the filter for removing flyash between the probe and absorption train. This allowed flyash to settle out in the quartz tube. With the low gas velocity through the tube, the gas would contact the flyash at 600 F for a comparatively long time and allow catalytic oxidation of SO_2 to SO_3. This would be especially true for oil firing where the ash contains a high percentage of V_2O_5.

In our apparatus the filter at the gas inlet end keeps the tube free from ash. Contact time for gas and ash is much less, holding catalytic oxidation to a minimum.

We have found that when sampling gas in high-temperature zones in oil-fired boilers, the Kaolin wool should be placed over the end of the quartz tube. Higher temperature of the wool under these conditions reduces catalytic oxidation of SO_2 by the flyash.

We found considerable oxidation when the filter was placed inside the tube, in the standard manner, in high-temperature zones. For successive tests made without changing the filter, at 1800 F or more, the SO_3 for succeeding tests were higher than the preceding tests. This result obviously followed from the increasing accumulation of ash. This was very marked for ash from fuel oil with a high vanadium content. The internal filter holds the oil ash at about 600 F and must be conducive to catalytic oxidation of SO_2 when sampling 1800-F gas.

When placing the filter outside the tube, its temperature stays at 1800 F; greatly reducing catalytic oxidation. When running successive tests with the filter at the end of the tube, the SO_3 stayed constant. No catalytic oxidation was found when using the internal filter in 700-F and 300-F zones.

We used a flowmeter instead of a calibrated orifice with a mercury manometer to measure gas flow. The flowmeter has at least equivalent accuracy and much more convenience for field work.

The desirable short-time sampling periods yields only a very small quantity of sulfate sulfur to measure. These can be measured by precipitation with benzidine hydrochloride (see reference 3) and the precipitate titrated with standard NaOH solution, or by a turbidimetric determination of a barium sulfate suspension. We found the latter the simplest and quickest to perform.

Methods of collecting and measuring SO_2 are numerous. These include: (1) absorbing in standard iodine solution and titrating with standard sodium thiosulphate (2) absorbing in standard NaOH and titrating with standard acid.

These methods use several standard solutions which may be difficult to maintain on field jobs so we discarded them in favor of the turbidimetric method described. Generally, a direct determination of SO_2 would be preferred to measuring by difference. In boiler flue gases, however, the total sulfur almost equals the SO_2 since the SO_3 is extremely low. So objections to measuring by difference are not significant since SO_2 is the major constituent. Our method requires only one standard H_2SO_4 solution, is simple to operate and especially convenient because the sulfate sulfur is measured by the same method.

When using sodium hydroxide absorption of SO_2 as in other methods, considerable CO_2 is absorbed appreciably affecting the measurement of gas sampled. When using NaOH, the amount of CO_2 absorbed must be measured and the gas sample volume corrected.

Hydrogen peroxide usually contains small amounts of sulfur. When 50 ml of H_2O_2 are used, however, the amount of sulfur is negligible unless extremely low concentrations of SO_2 (less than 0.10% by volume) exist in the flue gas.

When analyzing gas with extremely low SO_2 content, the sulfur content of the peroxide can be measured by analyzing the absorption solutions before passing flue gas into them and applying this correction to the analysis of the solutions after the flue gas has been sampled.

We tested the efficiency of the SO_3 absorption system of the apparatus. This was done by introducing a standard H_2SO_4 solution into a quartz tube heated to 700 F. Air was drawn through the quartz tube and sampling equipment at one liter per minute. Standard H_2SO_4 was added at the prescribed rate throughout the hour-long test. Total SO_3 added was more than twice the largest quantity of SO_3 collected when sampling gas from boilers. Table 1 shows the exceptionally good agreement between SO_2 added and recovered.

Table 2 shows the results of tests of oil-fired boilers in the field. They showed reasonably good agreement between theoretical total sulfur content of the flue gas and measured content.

Since calculated sulfur content of the gas depends on various analytical results, including fuel sampling and analyses and total air determination, it is not wholly free from error. Variations between calculated and measured values shown in Table 2 may not result entirely from errors in sampling and analytical methods used in this test. Possibly, the measured sulfur contents check the actual total sulfur present more closely during the sampling periods than indicated by Table 2.

Conclusions. The following points may be emphasized:

(1) This method gives improved sampling and analysis of boiler flue gas for SO_2 and SO_3.

(2) Results can be produced quickly and accurately under the adverse analytical conditions of a field testing program.

(3) Results can be obtained within one hour after sample collection. Therefore, a number of samples per day may be analyzed—results of any test being known before starting the next one.

(4) Unstable standard solutions have been eliminated. The one standard solution used, N/10 H_2SO_4, can be kept indefinitely without important change in strength.

(5) Need for laboratory facilities has been eliminated. The test needs only a small table, standard laboratory glassware and distilled water.

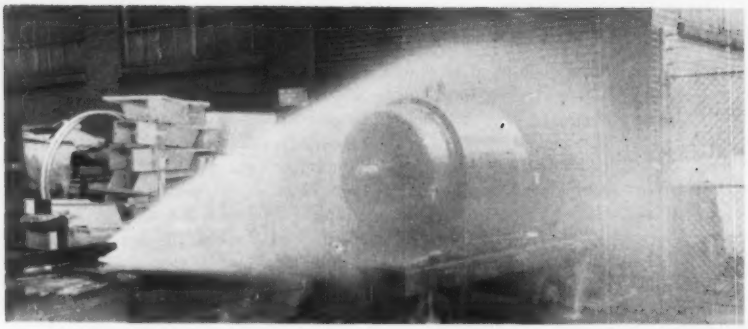
(6) Considering normal slight sampling and analytical tolerances, which may affect calculated and measured values, test results with this apparatus check the calculated fuel analysis and combustion data very well.

(7) SO_3 absorption system collects efficiently all the SO_3 that enters the sampling equipment and holds oxidation of SO_2 in the sampling train to a minimum. This insures accurate measuring of SO_3 in the flue gas at any location in the boiler.

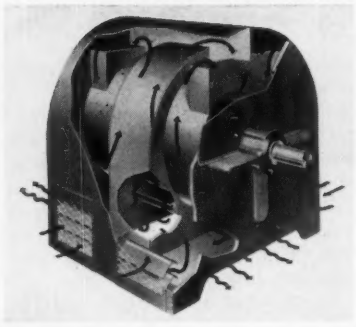
References. (1) Corbett, P F, *Journal Society of Chemical Industry*, vol 67, p 227, 1948.

(2) Flint, D, *Journal Society of Chemical Industry*, vol 67, p 2, 1948.

(3) Johnstone, H F, Univ of Illinois, Eng Expt Sta, Bulletin 228, 1931.



HOSE SPRAYS WATER on running 2300-v open motor with weatherproof insulation



AIR PATHS in a weather-protected motor

Weather-protected motors can take it

By **WILLIAM SCHNIEDER**
and **ROBERT M SEXTON**
Westinghouse Electric Corporation

► DURING THE PAST DECADE there has developed an ever-increasing demand for motors that operate satisfactorily and reliably in outdoor applications under extremes of weather. General approach has been to design special enclosures and construction features to keep weather elements from harming motor. Effectiveness of weather-protected construction has been proved by satisfactory service in severe applications. Now, increased dependability can be obtained by protecting windings with insulation impervious to moisture penetration or moisture deterioration. Several synthetic resin-impregnated, void-free, mica-insulated structures have been developed. These have high resistance to all contaminants and give windings stamina, elasticity to withstand rigorous physical stresses.

Motor construction for weather protection, sketch, above, encloses active working parts in inner protective housing with air inlet openings at top. Cooling air, shown by smooth arrows, enters enclosure through screened, louvered openings on each side of motor. Louvers give air a downward direction, then air reverses its direction and rises for considerable distance at low velocity before entering inlet openings at top of inner housing. The combination of sharp turn, sudden drop in velocity and relatively slow upward travel separates drops of water and dirt particles from air before it enters motor proper. Drains prevent water collecting within outer enclosure.

Hazards of rain and high-velocity wind being blown into motor intake openings are overcome by straight-through passages from one side of motor enclosure to other side. Straight-through passages, at ends of enclosure, permit wind-driven rain and dirt to be carried through bottom of housing under cylindrical end portions of inner enclosure rather than rising to inlets at top of inner enclosure. Extensive tests and operating experience have proved this construction effective.

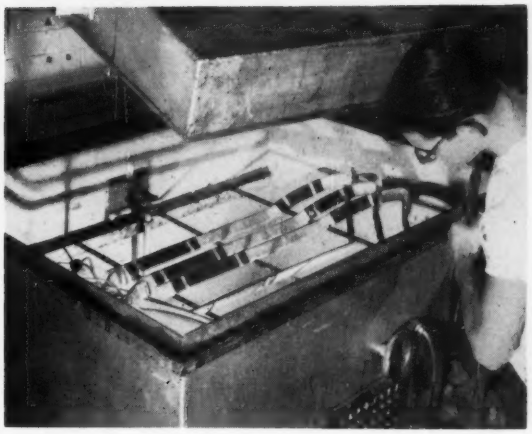
Vertical designs are similar. Air enters outer housing through screened openings, travels upward at low velocity over a baffle. Lip at top edge of baffle prevents water from being blown up its surface and over top into motor proper. All air enters inner housing at top and passes around thrust-bearing housing. This provides effective cooling for thrust bearing. About one-half of air then goes into top of motor around shaft; remainder is directed, through tubes in frame, to bottom of motor where it enters around shaft. Discharge air leaves stator core between tubes, travels over a baffle, down to screened discharge openings. Discharge openings are 90 deg from intake openings to reduce recirculation of heated air. As in horizontal motors, wind-driven rain can pass through outer enclosure and out opposite side.

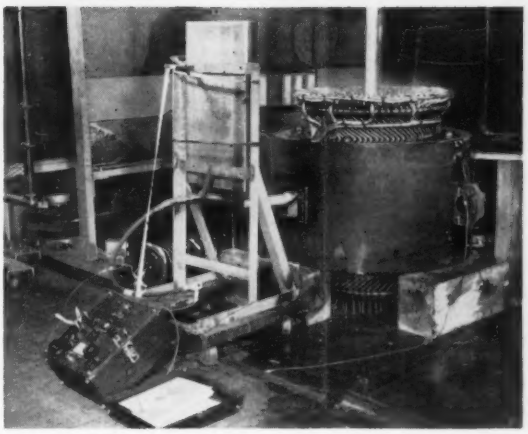
Weatherproof insulation for windings, because of absence of voids in insulation walls, makes penetration of the dense insulation barrier by liquids or other fine-particle contaminants practically impossible. Chemical inertness of synthetic resin impregnant gives added resistance to attack by solvents, lubricating oils, weak acids or alkalies and salt spray. Extensive tests and experience on actual installations have substantiated ability of weatherproof insulation to withstand the most severe service conditions encountered in outdoor applications.

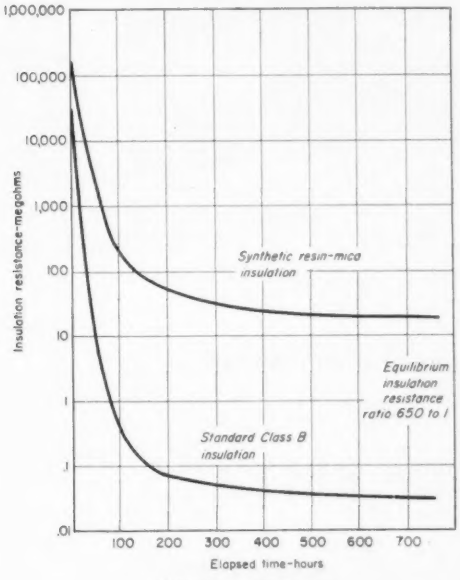
Two rigorous tests, conducted by Westinghouse engineers on their Thermolastic (synthetic resin-mica) insulation, produced results shown in curves, facing page. One test was made on a representative number of individual coils with synthetic resin-mica insulation and with conventional Class-B insulation. Coils were subjected to an atmosphere of 100% relative humidity at 50 C for various lengths of time up to 700 hours. Insulation resistance was measured at intervals. At the conclusion of the test, after a brief dryout, all coils were subjected to an overpotential test of 1.35 times the final acceptance test value of twice rated voltage plus 1000 volts. All the synthetic resin-mica insulated coils withstood this test whereas 25% of the conventionally insulated coils failed.

Soaking test was performed on Thermolastic-insulated coils in stator winding. Stator of 950-hp, 4160-volt motor was mounted vertically with standpipe through its center. Standpipe was equipped with nozzles that sprayed all parts of winding with water. Over 200,000 gallons of water were sprayed over winding during 275-hour test. For comparison, a standard Class-B winding was treated in the same manner. Insulation resistance of weatherproof winding flattened out at one megohm, while winding with standard insulation was only one-third as good.

Characteristics of weatherproof in-

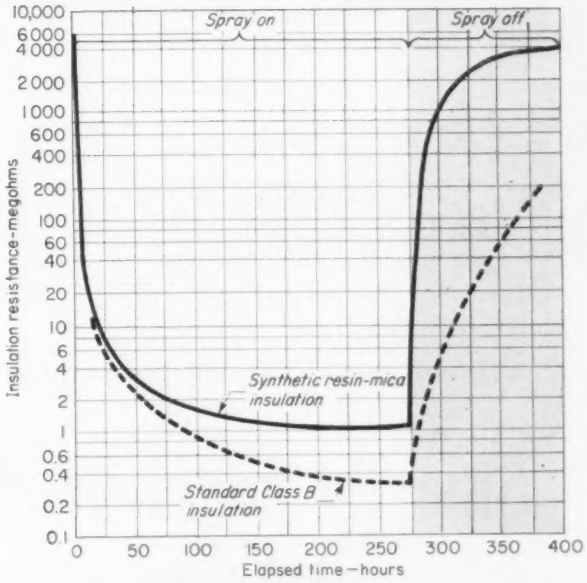






Wet-coil test

Individual coils with weatherproof insulation and standard Class-B insulation were subjected to an atmosphere of 100% humidity at 50 C for various time lengths to 700 hours



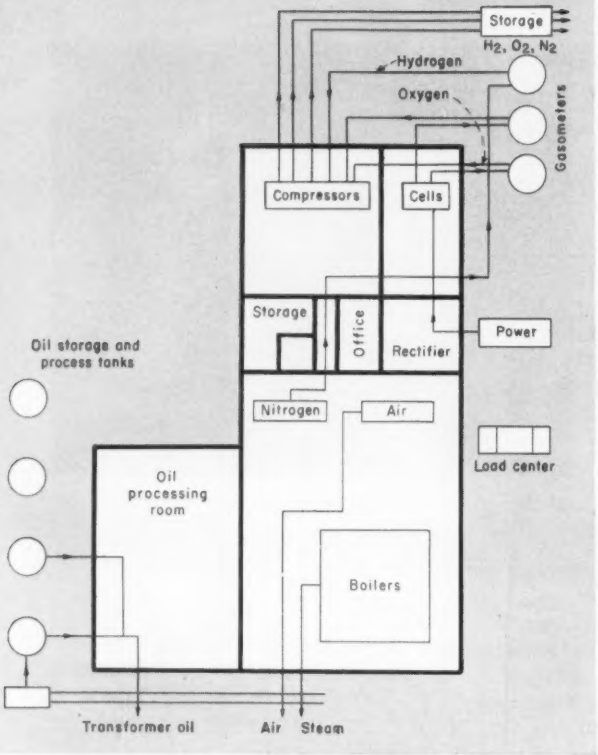
Wet-stator test

Winding with weatherproof insulation was sprayed with water in laboratory for 275 hours. Same treatment was given motor with standard Class-B insulation. Curves compare results

sulation are best shown in recovery portion of curves after water was shut off. Windings were not dried, but left in place at room temperature. During first part of recovery cycle, there were puddles of water under motors left from spray. In spite of these conditions, insulation resistance of weatherproof winding recovered to ten megohms in one hour. This rapid recovery proved that moisture was strictly a surface phenomenon, and had not penetrated into insulation walls.

Running test, simulating severe weather conditions, was conducted on an open-type motor rather than one with weather-protected construction, photo, top of facing page. The 950-hp, 2300-volt squirrel-cage motor had water sprayed on connection end by firehose while running at full voltage. During four days of test insulation resistance remained at 400 megohms.

Weatherproof insulation in conjunction with weather-protected construction of motor enclosures gives you maximum reliability for motors mounted in locations exposed to weather. Excellent performance of these motors recommends their use in many applications where formerly a special building would be constructed to house the motor and pumps or other driven equipment. In addition to their weather-protective advantages, today's weatherproof insulations generally have other improved properties: higher dielectric breakdown strength per unit thickness, increased voltage endurance (time to fail at given voltage), greater tensile strength throughout operating temperature range, better thermal conductivity, due to no voids (resulting in lower temperature drop across insulation) and greater thermal endurance.



SINGLE UTILITIES BUILDING houses boiler plant, gas plant and oil-processing area

A 3-in-1 power service package at GE's transformer plant:

Smartly engineered plant services trim $100,000 from initial costs

By W R ATKINSON

Supervisor, Plant Facilities

► To get a quick glimpse of the plant services at General Electric's distribution transformer plant at Hickory, North Carolina, visualize a boiler room generating steam and compressed air, a gas plant producing nitrogen, oxygen and hydrogen, and an oil house processing transformer oil—all of these in large quantities—packaged in a single building and run by two operators per shift. Add to this picture the latest automatic equipment, efficient layout, and you've got the key elements in this group of smartly engineered plant services.

Boiler room. Steam, compressed air and nitrogen facilities—all being nonexplosive—are located together i the boiler room. And since all three ypes of equipment are automatic, our : ctivities are limited to start up and hourly checks.

Boiler-room units include two 30,000-lb-per-hr gas- or oil-fired package boilers, two nitrogen producers rated 2000 cfh, and two 1133-cfm 100-psig air compressors.

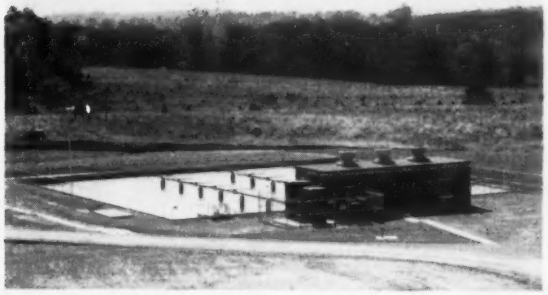
Gas plant. We consider the gas plant end of the building hazardous because of the hydrogen. Thus we've installed explosionproof equipment in this area and have separated it from the boiler room, office and storage area by 12-inch cinder-block walls.

We produce hydrogen and oxygen by the electrolytic process, using germanium rectifiers for power supply. Gasometers receive the hydrogen, oxygen and nitrogen. Gases then go to identical water-cooled, lubricated compressors and are stored at 1000 psig.

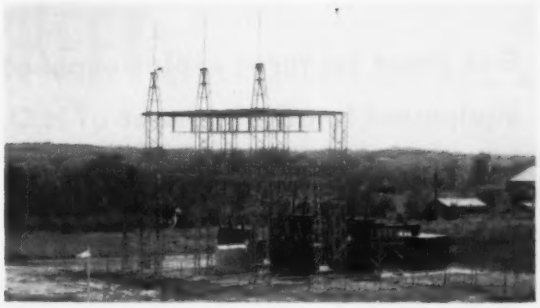
Oil room, operating independently of the boiler room and gas plant, filters, deaerates, inhibits and pumps transformer oil to the plant. Here, too, controls have been engineered for minimum operator supervision.

Economics. Overall operation requires eight operators for continuous 24-hr operation; similar plants often require 18 men. Thus, manpower savings are about $40,000 per year. And savings in building construction, as a result of fewer outside walls, single power supply and water supply, run to a whopping $100,000.

There's plenty of room for outdoor service facilities

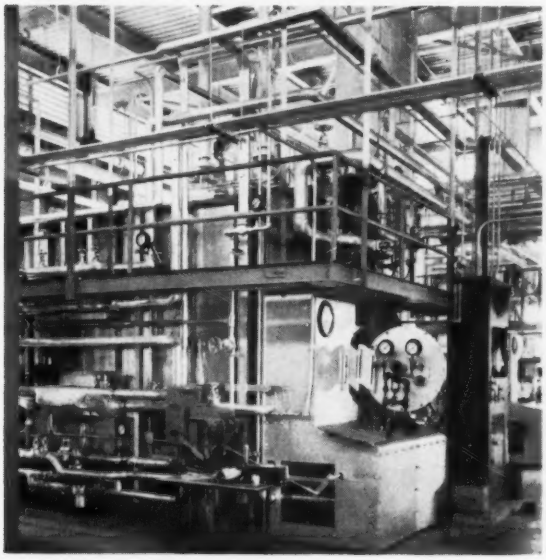


SPRAY POND cools and recirculates uncontaminated water used in transformer manufacturing processes. Cooling water is a key power service at GE

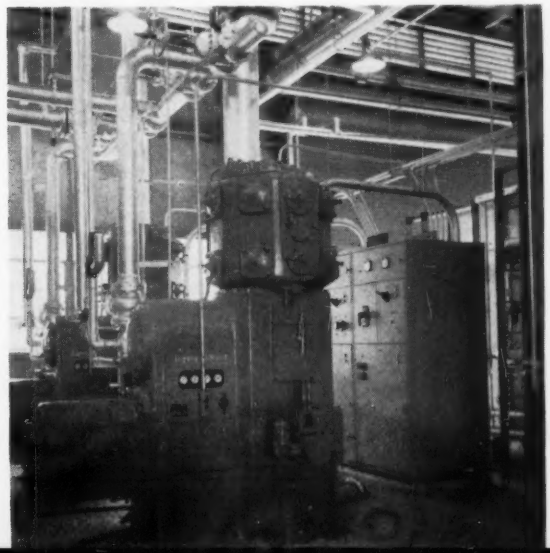


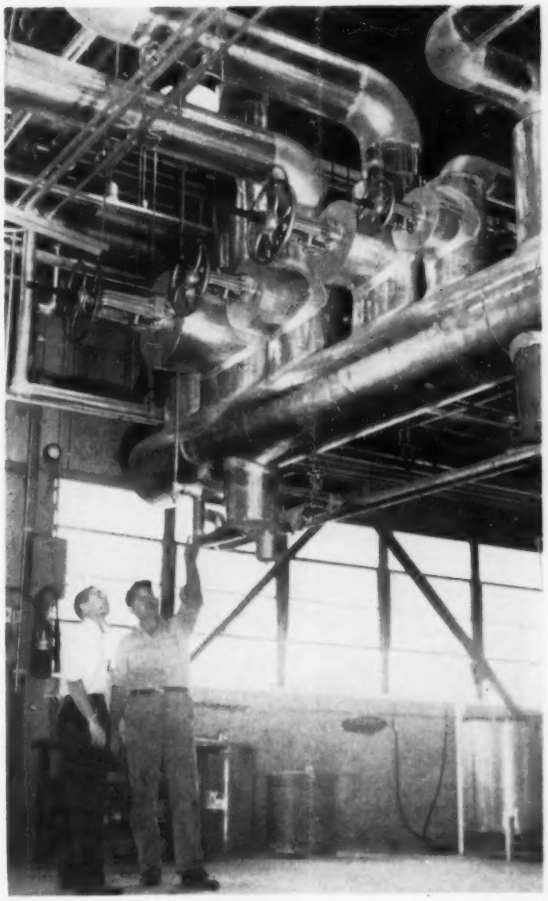
MAIN SUBSTATION receives 100-kv power from Duke Power Co, transforms it to 13.8 kv. It then goes to the plant via underground cables

The boiler area also houses compressed air, nitrogen services



PACKAGED TYPE BOILERS, two units, each rated 30,000 lb per hr, 270 psig, can be fired with natural gas or No. 6 fuel oil



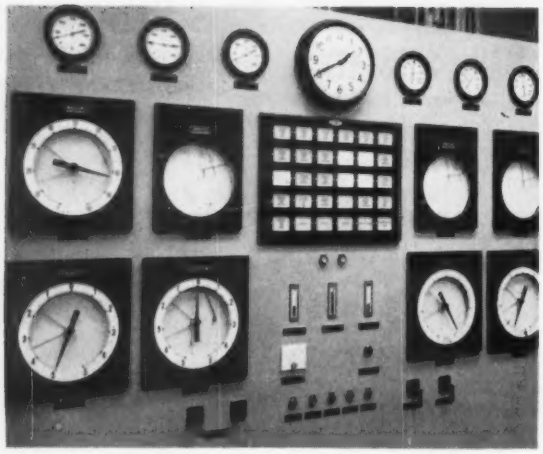


MAIN STEAM HEADER is manifolded to supply steam for heating and process to areas in the plant. Sheathing cuts heat losses

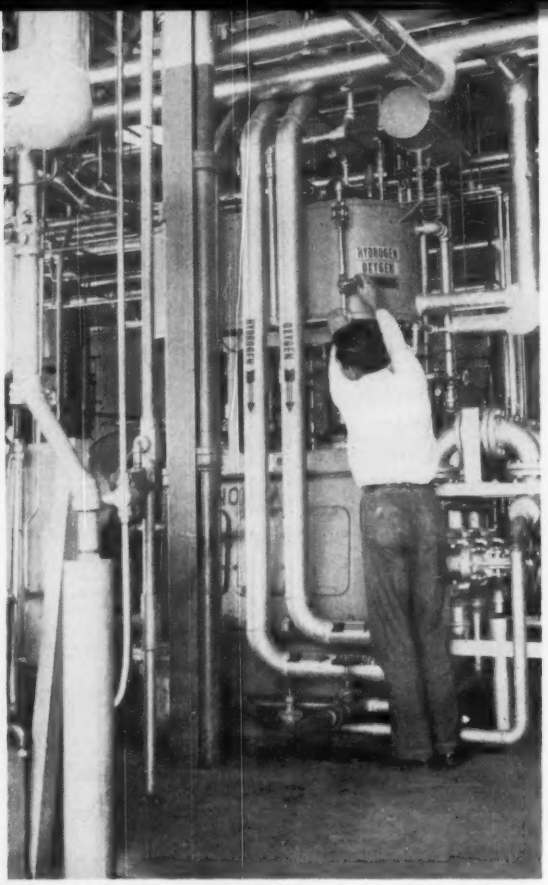
AIR COMPRESSORS supply plant air at 100 psig. Two units are rated at 1133 cfm each. These compact units save on space, manpower

Turn page

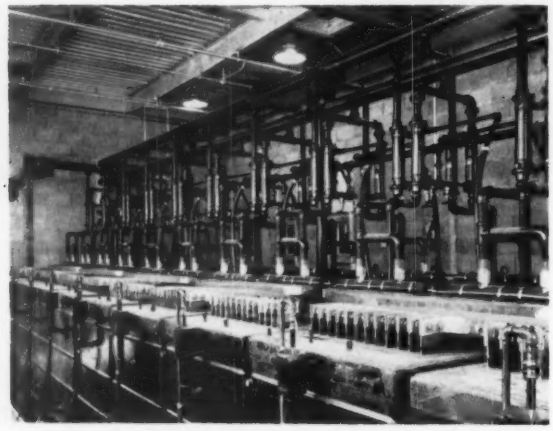
Gas plant features explosionproof equipment to offset danger of H_2O_2



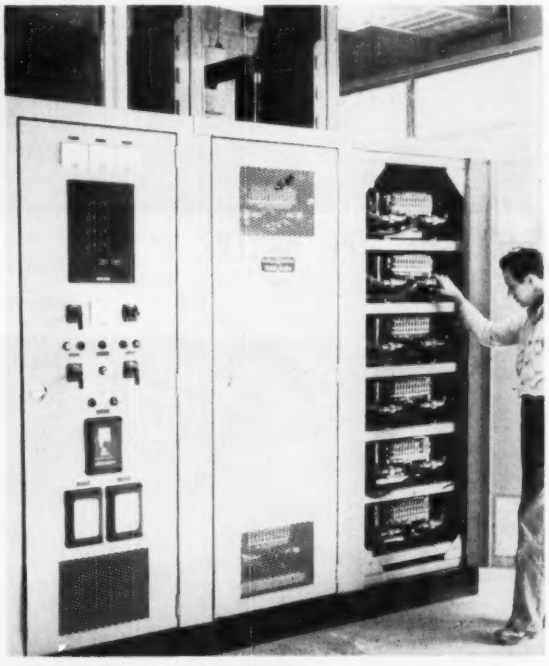
CONTROL PANEL in office area provides operators with information, controls for the gas plant. It also contains alarms for oil, boiler, gas areas



COMPRESSOR ROOM in gas plant. Hydrogen and oxygen collected from cell room is pumped into storage tanks or directly to the plant



ELECTROLYTIC CELLS, 22 of them, generate hydrogen and oxygen. Each cell contains 12 anodes, 13 cathodes. Gas is almost 100% pure



GERMANIUM RECTIFIERS supply direct current for the electrolytic dissociation of hydrogen and oxygen. Dc power goes to cells

Power's DATA SHEET

No. 304

Properties of steam at gage pressures

Pressure, psig	Temperature, F	Specific volume, cu ft per lb: Water	Specific volume, cu ft per lb: Steam	Enthalpy of liquid, Btu per lb	Enthalpy of evaporation, Btu per lb	Entropy, Btu per lb per F: Water	Entropy, Btu per lb per F: Steam
0	212.0	0.01672	26.80	180.1	970.3	0.3120	1.757
10	239.4	0.01692	16.50	207.7	952.6	0.3523	1.715
20	258.8	0.01708	12.00	227.4	939.5	0.3800	1.688
30	274.0	0.01721	9.462	242.9	928.9	0.4013	1.667
40	286.7	0.01732	7.828	255.9	919.9	0.4188	1.651
50	297.7	0.01743	6.684	267.2	911.8	0.4338	1.638
60	307.3	0.01753	5.838	277.1	904.7	0.4468	1.626
70	316.0	0.01761	5.186	286.1	898.0	0.4584	1.616
80	323.9	0.01770	4.666	294.3	891.9	0.4689	1.607
90	331.1	0.01778	4.244	301.9	886.2	0.4784	1.599
100	337.9	0.01785	3.892	308.9	880.8	0.4872	1.591
110	344.1	0.01792	3.595	315.5	875.6	0.4954	1.585
120	350.0	0.01800	3.340	321.7	870.7	0.5030	1.578
130	355.6	0.01806	3.120	327.5	866.0	0.5102	1.572
140	360.8	0.01812	2.927	333.1	861.5	0.5170	1.566
150	365.8	0.01818	2.757	338.4	857.2	0.5233	1.562
160	370.6	0.01824	2.606	343.4	853.0	0.5294	1.557
170	375.2	0.01830	2.470	348.3	848.9	0.5352	1.552
180	379.5	0.01835	2.348	353.2	845.0	0.5407	1.548
190	383.7	0.01842	2.237	357.4	841.2	0.5459	1.543
200	387.8	0.01847	2.137	361.8	837.5	0.5510	1.539
210	391.7	0.01852	2.045	366.0	833.9	0.5560	1.535
220	395.4	0.01857	1.960	370.0	830.4	0.5607	1.532
230	399.1	0.01863	1.883	374.0	826.9	0.5652	1.528
240	402.6	0.01868	1.811	377.8	823.5	0.5696	1.525
250	406.0	0.01873	1.744	381.5	820.2	0.5739	1.521
260	409.3	0.01878	1.682	385.1	817.0	0.5780	1.518
270	412.6	0.01883	1.625	388.6	813.8	0.5820	1.515
280	415.7	0.01887	1.571	392.1	810.6	0.5859	1.512
290	418.7	0.01892	1.520	395.4	807.6	0.5896	1.509
300	421.7	0.01896	1.473	398.7	804.6	0.5933	1.506
320	427.5	0.01906	1.386	405.0	798.6	0.6004	1.501
340	433.0	0.01915	1.309	411.1	792.9	0.6072	1.495
360	438.2	0.01923	1.240	416.9	787.3	0.6137	1.490
380	443.3	0.0193	1.177	422.6	781.9	0.6198	1.486
400	448.1	0.0194	1.120	428.0	776.5	0.6257	1.481
420	452.8	0.0195	1.069	433.3	771.3	0.6314	1.477
440	457.3	0.0195	1.021	438.4	766.2	0.6369	1.472
460	461.7	0.0196	0.9780	443.3	761.2	0.6422	1.468
480	465.9	0.0197	0.9380	448.1	756.3	0.6474	1.464
500	470.0	0.0198	0.9011	452.9	751.4	0.6523	1.461
600	488.8	0.0202	0.7508	474.6	728.4	0.6752	1.443
700	505.4	0.0206	0.6413	494.3	706.5	0.6953	1.427
800	520.3	0.0209	0.5578	512.3	685.9	0.7134	1.413
900	533.9	0.0213	0.4918	529.0	665.9	0.7299	1.400
1000	546.4	0.0216	0.4386	544.6	646.6	0.7452	1.388

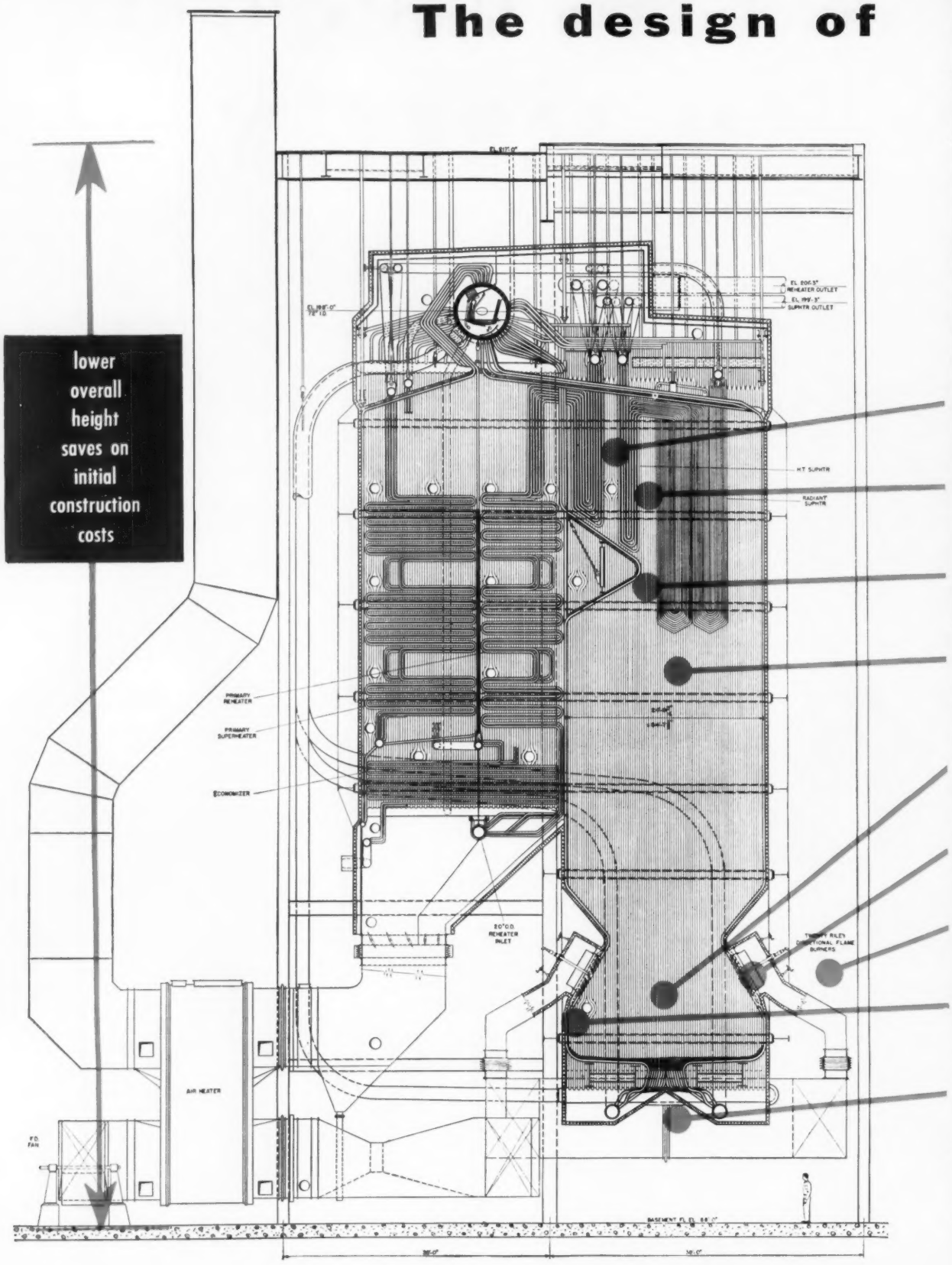
Interpolated from Keenan & Keyes—"Thermodynamic Properties of Steam."

Based on barometric pressure—14.696 psia.

© POWER

The design of

lower overall height saves on initial construction costs



the future that's HERE!

the RILEY TURBO FURNACE

- No major alteration in pressure parts when changing from gas and oil to solid fuels
- Same furnace exit gas temperatures with all fuels
- Slag blowers may be eliminated
- No stratification of furnace gases Furnace walls stay clean
- High turbulence and long residence time of fuels promotes negligible carbon losses
- Directional flame burners for multiple fuels
- Burner location on one level permits turbine level operation
- With Flyash reinjection, unburned losses are negligible
- Slag tapping with reinjection eliminates flyash disposal problem

The unit illustrated is being built at Sterlington Station for Louisiana Power & Light Company. Steam capacity—1,600,000 lbs./hr.—2125 psig. 1005 F. Reheat. Fuel will be gas and oil initially. Pulverized coal, fluid coke or lignite can be fired at anytime in the future.

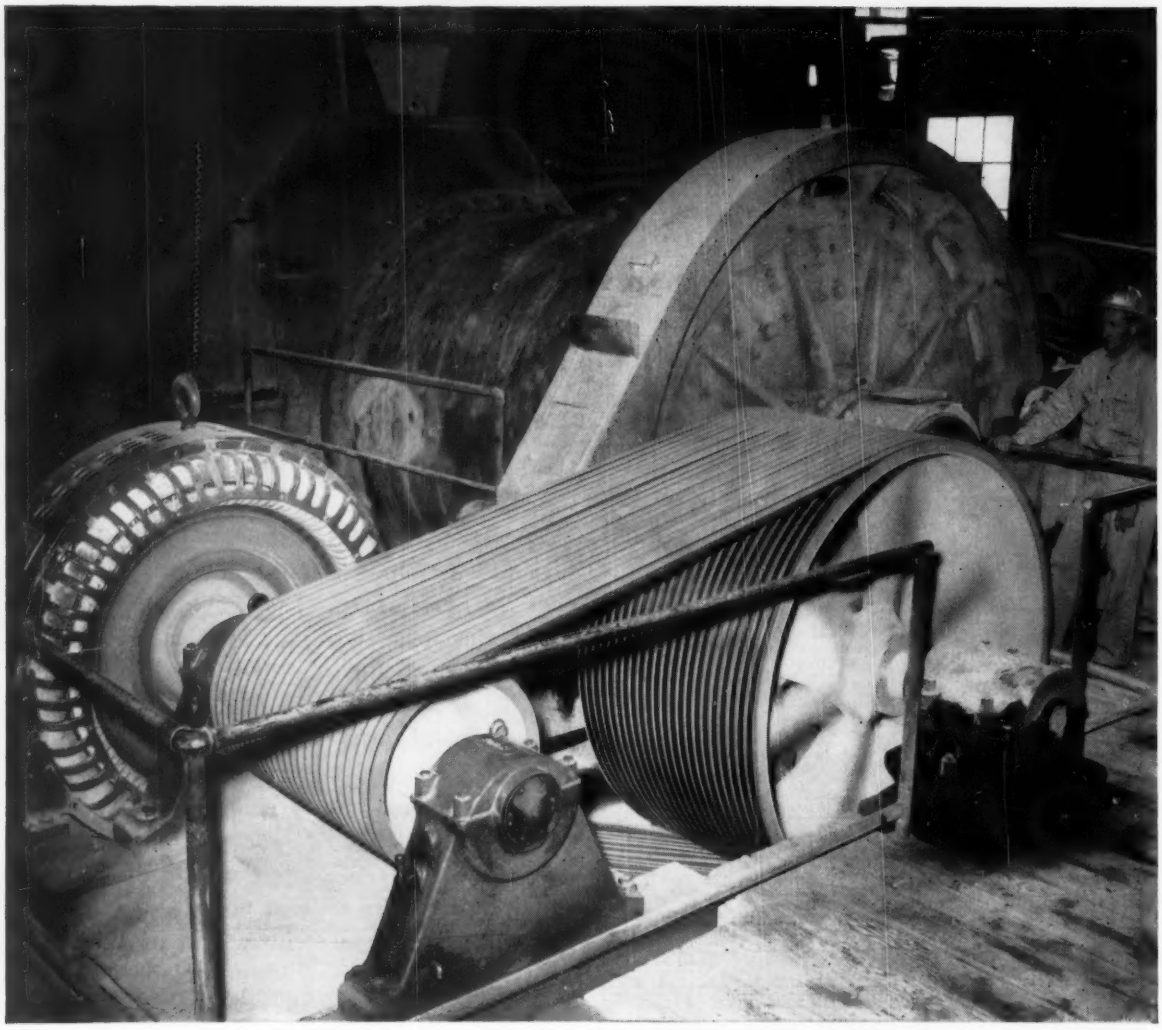
The Riley TURBO FURNACE Boiler Design has enjoyed a remarkable acceptance since it was first introduced late in 1954. Because of its versatility it has been incorporated into boiler capacities from 150,000 up, reheat or non-reheat, pressurized and non-pressurized. The TURBO FURNACE has been purchased to satisfy numerous operating requirements: to be able to fire multiple fuels, for quick low cost conversion from gas or oil to coal or other solid fuels, to burn fluid coke as a major fuel, to eliminate slagging and slag blowers, to refire flyash and thus eliminate flyash disposal. Twenty TURBO FURNACE units have been sold for industrial and central station installations totalling over ten million pounds of steam per hour. It will pay you to investigate to get the full story on the extra dividends possible in a TURBO FURNACE unit.

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

RILEY
Stoker Corporation
WORCESTER, MASSACHUSETTS

Sales Offices: Worcester, New York, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver (Englewood), Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

B.F.Goodrich report:



Big steel gizzard grinds rocks

B. F. Goodrich improvements in rubber brought extra savings

Problem: As long as that big steel drum (at left) keeps turning, it does a beautiful job of grinding copper ore into powder. Hundreds of steel balls do the grinding, just as pebbles in a chicken's gizzard pulverize food.

But getting that heavy mill to turning from a dead stop, sometimes snapped one or more V belts like pieces of string. Even after starting, the strain of keeping it going wore out belts before their time.

What was done: When a B.F.Goodrich distributor heard of the problem, he recommended Grommet belts, a different kind of V belt developed and made only by B.F.Goodrich. On the outside a Grommet belt looks like any other V belt. But buried inside are two cord loops, made like twisted cables except that they're endless—no splices or overlaps. It's these two grommets that make the B.F.Goodrich belt strong enough to pull heavy loads and take sudden jerks without going to pieces.

Savings: The set of B.F. Goodrich belts shown above have been on the job nearly 6 years now—longer than any V belts used before—and they show no signs of wearing out. They've never needed to be adjusted, haven't lost a minute of the copper company's time.

Where to buy: Your B.F.Goodrich distributor has full information on the B.F.Goodrich belts described here. And, as a factory-trained specialist in rubber products, he *can* answer your questions about *all* the rubber products B.F.Goodrich makes for industry. *B.F.Goodrich Industrial Products Co., Dept. M-208, Akron 18, Ohio.*

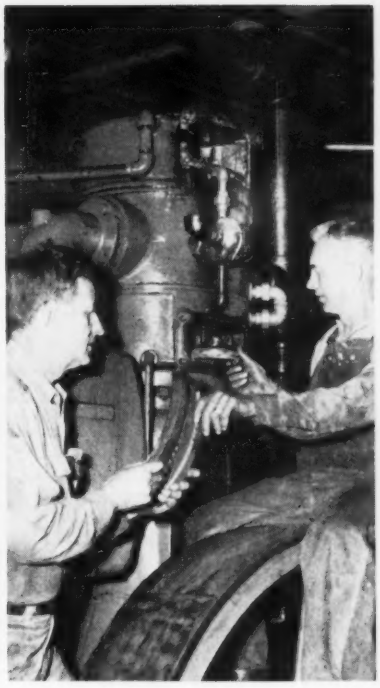
Grommet—T. M. The B. F. Goodrich Co.

B.F.Goodrich

INDUSTRIAL PRODUCTS

STEVE ELONKA
Associate Editor in Charge

They adjust rectifier stacks . . .



. . . overhaul air compressor . . .

. . . give substation transformer checkup

Here's a modern manufacturing plant that gets best results with . . .

All-round maintenance men

By **Milton P Laursen**
Chief Industrial Engineer
Marchant Calculators, Inc

► IN THE MANUFACTURING of small, varied parts for complicated products like business machines, varieties of processes and equipment are necessary. Marchant Calculators, Inc, Oakland, California, believe that they have a unique setup in that all maintenance employees are of one classification—*maintenance man*. All the men belong to the same union. Through an intensive cross-training program, nearly every man in the maintenance department is capable of trouble-shooting any maintenance problem, and is qualified to assume full responsibility on any shift.

Turn page

JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER

EQUIPMENT RECORD SHEET

EQUIPMENT: Electronic Heater (Induction Heater) WEIGHT:

Output - 20 KW Freq. 510/540 Max. R-F Current, 250 amps. Power Supply 230V, 3 Phase, 50/60 Cycles, 150 amps

MFG. BY: General Electric Inst. No. GEI. 24334

EQUIP. NO.: 742 - 40 SERIAL NO.: 7051

FORM 57 DATE	JOB ORDER	DESCRIPTION OF WORK	REMARKS	LABOR	PARTS
6-4-56		New Bearings installed. (W.D. 37-7037)		1 Hr.	
8-30-56		Large Induction Heater tube GL 880 shorted Grid to Filament; meter reading 07079 hrs. Old tube removed and new one installed.		1½ Hrs.	
10-6-56		Hour-meter reading 07290 5-GE Rectifier Tubes #GL 673 replaced.		½ Hr.	
10-13-56		One rectifier tube replaced.		½ Hr.	
11-16-56		Filament Voltage. Cleaned contacts #K-203. Hour-meter reading 7504 Hrs.			
1-31-57		Induction Heater Check off list completed this date. 12209 − 11858 = 351 Hrs. on GL 880			
2-28-57		Induction Heater Check off list completed this date. 12377 − 12209 = 168 Hrs. on GL 880			

PARTS INVENTORY REF.:

Equipment record sheet

There's variety of electric equipment

FORM 1035 — INVENTORY CARD — PLANT ENGINEERING DEPT.

PURCHASE REQ. NO.	QUANT.	DATE		PRICE	PURCHASE ORDER NO.	QUANT.	DATE ORDERED	DATE RECEIVED	QUANT RECEIVED	JOB ORDER NO.	ISSUED	ORDER POINT	ON HAND
35408	6	10-13-54		—	664	6	10-15-54	10-28-54	6	—	—	—	—
35443	5	1-20-55	RE-PAIRED	—	2078	5	1-24-55	3-21-55	5	—	—	—	—

ADDITIONAL INFORMATION: Equip. No. 742-40 For G.E. Induction Heater 20 K.W. Freq.

EQUIP. NO. REFERENCE: None

USAGE	DATE	PARTS PER MACHINE	LOCATION
		ORDER QUANT.	

PART NAME: Phanotron Rectifier Tubes (GL 673) PART NO. EQUIP. NO.: 742-40

Inventory card for replacement parts

Diversified skill has been one benefit of the cross-training program. Another is that the men welcome the opportunity to broaden their knowledge, and this is considered to be a factor in the negligible turnover in the maintenance department. Of course there's a certain amount of specialization, but trade barriers don't exist. A man can perform electrical or sheet-metal work, painting, rigging, etc. within a day or an hour without criticism from others.

Some important features of the maintenance picture are:

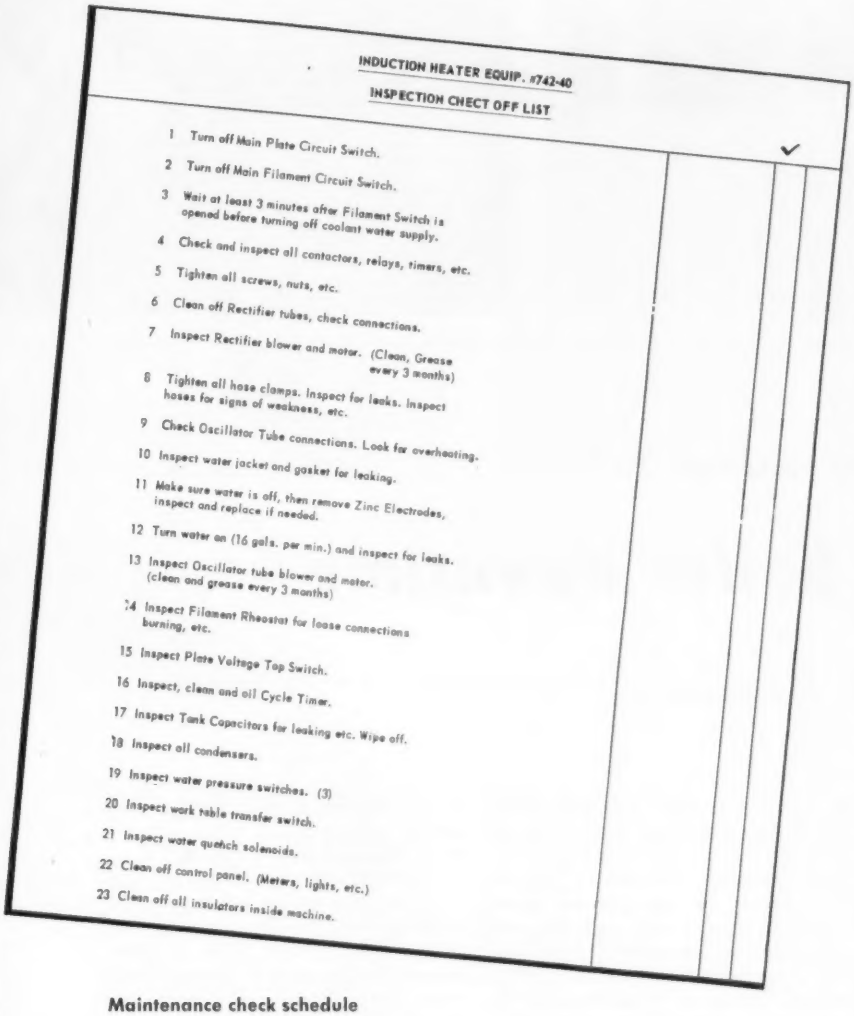
(1) Plant is serviced by maintenance men on all three shifts. The plant is producing predominantly on the day shift, with a partial swing shift operating and an idle graveyard shift.

(2) Maintenance department is responsible for all utilities, services, buildings and grounds, and must therefore have these services available at the start of the work day.

(3) A maintenance engineer directs the efforts of 20 maintenance men in a plant having over 1900 employees. The maintenance engineer reports to the chief industrial and plant engineers. The maintenance department has staff engineering aid from project engineers in plant engineering, who also report to the chief industrial and plant engineer.

(4) An intensive training program is set up for the several skills required.

Responsibilities. Major maintenance responsibilities are as follows: Large heat-treating furnaces must be checked regularly for proper temperature, thermocouples, controlled atmospheres, dew-point controllers, gas- or electric-fired generators. Induction heaters require maintenance on water filters, pumps and electrolysis rods, as well as oscillator tubes and complex control circuits. Automatic plating equipment must be checked for various components such as steam coils, regulators, hydraulic pumps and mechanical valves, as well as direct-current rectifiers, limit switches, electronic control timers and relays. Similar maintenance is required for automatic degreasers, screw



INDUCTION HEATER EQUIP. #742-40

INSPECTION CHECT OFF LIST

	✓
1 Turn off Main Plate Circuit Switch.	
2 Turn off Main Filament Circuit Switch.	
3 Wait at least 3 minutes after Filament Switch is opened before turning off coolant water supply.	
4 Check and inspect all contactors, relays, timers, etc.	
5 Tighten all screws, nuts, etc.	
6 Clean off Rectifier tubes, check connections.	
7 Inspect Rectifier blower and motor. (Clean, Grease every 3 months)	
8 Tighten all hose clamps. Inspect for leaks. Inspect hoses for signs of weakness, etc.	
9 Check Oscillator Tube connections. Look for overheating.	
10 Inspect water jacket and gasket for leaking.	
11 Make sure water is off, then remove Zinc Electrodes, inspect and replace if needed.	
12 Turn water on (16 gals. per min.) and inspect for leaks.	
13 Inspect Oscillator tube blower and motor. (clean and grease every 3 months)	
14 Inspect Filament Rheostat for loose connections burning, etc.	
15 Inspect Plate Voltage Tap Switch.	
16 Inspect, clean and oil Cycle Timer.	
17 Inspect Tank Capacitors for leaking etc. Wipe off.	
18 Inspect all condensers.	
19 Inspect water pressure switches. (3)	
20 Inspect work table transfer switch.	
21 Inspect water quench solenoids.	
22 Clean off control panel. (Meters, lights, etc.)	
23 Clean off all insulators inside machine.	

Maintenance check schedule

machines, etc, and for normal utility equipment such as process boilers, substations, air compressors and air-conditioning equipment.

Furnaces for atmosphere heat treating are complex and critical, operate on a round-the-clock schedule. Every six months these furnaces are shut down and preventive maintenance is performed on overtime in order to restore them to the line with a minimum of lost production. During this shutdown the overhaul crew checks all fire tubes, brickwork inside the furnaces, the conveyor assembly, etc. Quenching oils are checked. All motors are inspected and control panels tested.

Induction heaters are used to weld four or five parts together in the fabrication of subassemblies. These induction heaters are operated on a megacycle band and licensed by the Federal Communications Commission. Their components include a water-cooled oscillator tube, rectifier and control panels. These are carefully examined for corrosion of contacts, limit-switch performance, etc. A half-hour shutdown once a month assures proper performance of this vital equipment.

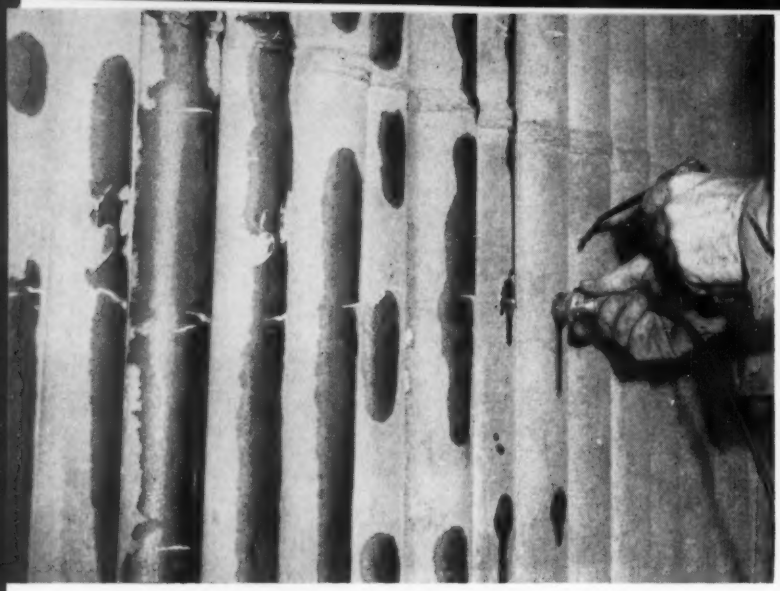
Automatic platers are used to cadminum plate internal parts. Push-bar contacts, controls, limit switches and the hydraulic system require careful maintenance. This equipment also gets a half-hour shutdown once a month. At this time the operator checks his plating solutions, and informs the maintenance department of minor malfunctioning of his equipment. Preventive maintenance can then be done to avert possible major repairs and lost time.

Screw-machine motors are thoroughly cleaned every three months, since this is a critical area for oil and dirt accumulation. Bearings, switches and electrical contacts are also checked at this time. All oil-lubricated bearings are checked once a month, and cleaned and relubricated if necessary. Grease-lubricated bearings receive the same attention on a 3-month schedule. Most motors in the plant operate on a 2-shift basis five to six days a week.

A card file, the lifeline of the preventive-maintenance program, is the responsibility of a maintenance clerk. Included in the file are equipment cards, spare-parts cards, maintenance-history cards, etc. These cards are tabbed for weekly, monthly, bi-monthly, quarterly and annual maintenance. In addition, critical equipment is flagged. Information concerning the various equipment is typed on house telegrams and directed to the respective leaderman, with a positive follow-through by the maintenance engineer. A necessary equipment shutdown is prearranged with the production foreman. Major overhauls are scheduled on written job orders. Critical equipment that cannot be removed from the production line is scheduled on an overtime basis for graveyard-shift or weekend maintenance. The maintenance-history cards, above, provide all necessary information, including manufacturers' operating and maintenance recommendations.

Production shutdowns are scheduled at yearly intervals for 2-week periods. At this time (while production people are on vacation), the maintenance department takes over the plant. Substations, boilers, compressors and other utility equipment are given a thorough going over.

Installation, including heavy equipment, rarely requires outside services. Here again, the all-round training program pays extra dividends. The maintenance team is responsible for the equipment from the time it is delivered. They make the initial installation, operate it for tests and inspection, and schedule it for routine maintenance.



RESONANT FREQUENCY of tube accurately indicates wall thickness. Instrument's calibrated harmonic scales give direct reading

Ultrasonic resonance tests can . . .

Cut your boiler downtime

By J L EVERETT and J H DANIELS, *Philadelphia Electric Co*

Ultrasonic testing: pulse vs resonance

Main difference is that pulse (echo) type is used primarily for detecting flaws. Image on the scope represents distance between ingoing and returning signals in terms of a given thickness. Any signal (usually smaller) between the two indicates some discontinuity within the material. However, flaw's depth can only be approximated. Pulse type can't be used for checking material's actual thickness within a few thousandths of an inch, though in its field it's an invaluable inspection tool.

Resonance type instrument is actually an electronic micrometer used to measure thickness, from one side of material, within tolerances of ±0.002 in. in some applications. Its use doesn't conflict with pulse type.

► ULTRASONIC RESONANCE testing bids fair to take a top spot in the array of methods aimed at knocking big chunks from equipment maintenance and repair expense. In any industry forced outage of a production unit can raise hob with the operating budget, and this is particularly true of the electric utility. Outage of a modern high-efficiency steam generator may up production costs as much as $50 per mw per day. For example, a one-day loss of a 200-mw unit could cost $10,000.

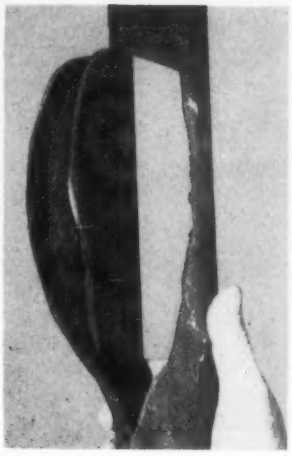
It's easy to see why any method or technique that would prevent another outage, or at least cut its duration, sparks a utility's interest. Ultrasonic resonance testing falls into this category so far as the Philadelphia Electric Co is concerned.

Because of suspected tube leakage the Cromby Station's No. 1 unit (1800 psi, 1000 F/1000 F) was taken out of service in September 1956. Investigation showed three leaking furnace-wall tubes. The faulty sections were cut out and found to have heavy copper- and iron-oxide deposits over the corroded areas. In every case these corroded areas were above bends in the tubes. Three were just above bends in two adjacent tubes forming a soot-blower opening and a fourth above a bend forming a burner opening.

A previous failure of this type in an arch tube of a similar boiler prompted a decision to test the bent-tube sections of the Cromby boiler in some manner to determine if other corroded areas were present. Ultrasonic resonance testing looked like a good bet because it offered a quick, nondestructive method of determining metal thickness. Using a Vidigage, we checked all the furnace tubes near wall blower openings, inspection ports and burners in the "A" section of the divided furnace and sounded out all arch tubes in both "A" and "B" sections.

No further trouble was found. However, we got one low reading which almost led us to discontinue using the instrument. The reading indicated a reduced metal-thickness area on one of the arch tubes. We sectioned the tube and were chagrined to find that, visually, it seemed perfectly all right. But one diehard insisted on cross sectioning the tube at the indicated low spot. We then found good reason for the instrument's behavior: a circumferential lamination probably caused by a slag

Electronic detective puts the finger on potential trouble spots



CORROSION caused rupture of tube, *top left*. Thinning wall caused easily seen "blisters" on fireside of others, *center*. Adjacent tubes looked healthy, but corrosion was suspected. Ultrasonic resonance testing picked out a number of these, indicated dangerously thin walls. Typical section, *right*, showed extent of internal wasting, proved instrument's reliability and the value in blocking a forced shutdown

inclusion when the tube was formed.

After repairs were made, the boiler was rinsed with a copper solvent, acid-washed and returned to service.

The big test for the resonance testing equipment was yet to come. Two weeks after return to service, one of the furnace sidewall tubes let go. (This particular tube hadn't been checked with the instrument.) Inspection showed 12 blistered tubes in the "A" and "B" furnace sections and a ruptured tube in the "B" sidewall. Each sidewall has about 70 tubes, with failures confined largely to those in the rear half.

We removed and sectioned a tube adjacent to the one that failed, even though it showed no visual signs of damage. The inside was heavily corroded and had a very distinct layer of copper plating.

These failures, we believe, resulted from the previous copper- and acid-washing. Apparently, all the copper wasn't removed and the acid-washing plated it to the bare tube metal. In operation, boiler-water salts penetrated the copper film forming a perfect cell for starting the corrosion process. Since we didn't know the extent of the damage, we decided to analyze the entire furnace in the burner zone.

Before testing, we sandblasted the tubes to get a good contact surface for the instrument. We started to polish the tubes but found that it wasn't necessary because the liquid couplant gave good energy transmission to the sandblasted surfaces. Incidentally, because the instrument is fairly small, we were able to hoist it into the furnace via the ashpit.

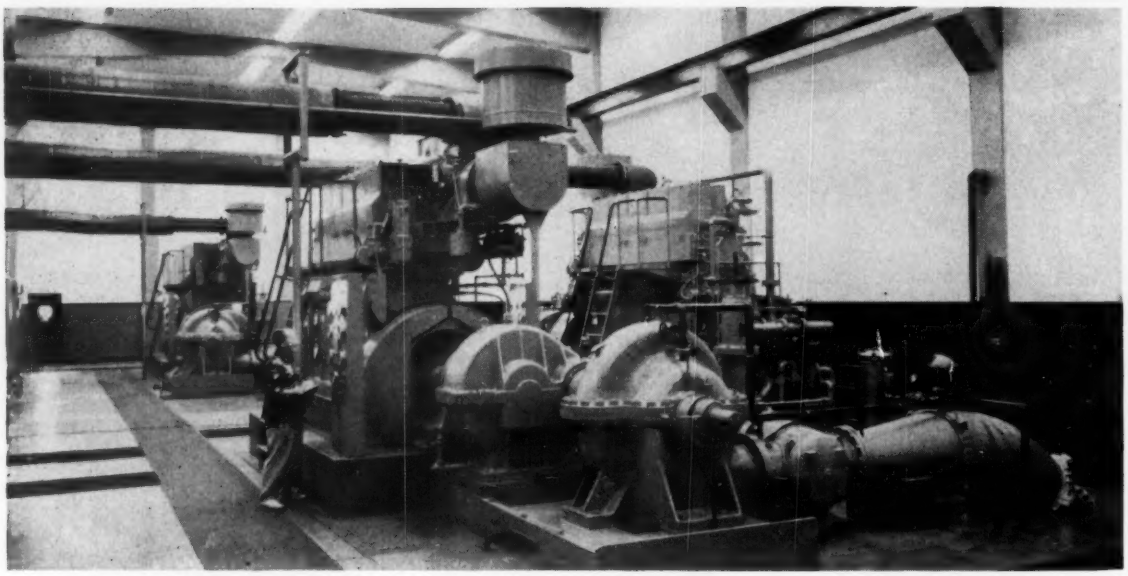
We checked the furnace and division walls to about 30 ft, starting 5 ft above the top row of burners. We took readings every 6 in. on the fireside of the tubes—closer readings in suspect areas. We checked about 600 tubes, taking about 35,000 readings.

Not once did the instrument show a high or low reading which wasn't justified. One tube showed that the indicated "thinness" was caused by eccentricity, not corrosion. All in all, the resonance testing revealed 11 tubes that were visually all right but corroded internally to the point where replacement was necessary. In addition, we found a great number of tubes in which corrosion had started but wasn't serious enough to require tube replacement at the time. Knowing their true condition, however, was a big advantage.

Ultrasonic resonance testing employs a simple instrument, easy to use, reliable and, judging by the abuse it took inside the sooty boiler, ruggedly built. Thickness range of the instrument is from 0.005-in. to 2.5-in., though for our purpose we used a considerably narrower band, 0.158-in. to 0.352-in., with 0.002-in. divisions. Instrument accuracy is within ±1%.

A major advantage: instrument reading isn't thrown off by scale deposit on the inside of the tube. Some other test instruments have a tendency to average the total thickness of various materials under the probe. Thus a thin-walled tube, heavily scaled, could easily show the same reading as a clean thick-walled tube. Ultrasonic resonance equipment, on the other hand, shows only the thickness of true metal under the probe, whether the tube is full, empty, clean or badly scaled.

Another advantage is the instrument's quick response. The reading is immediate, as soon as the probe is applied to the metal under test.



Four years without forced shutdown for these water-works diesels. Answer? . . .

Preventive diesel maintenance

By **MAX GREITZER**, *Mechanical Engineer, Miami, Florida*

► RIGID MAINTENANCE SCHEDULES are paying off as diesels grind away after 8000 to 12,000 hours without a forced shutdown. These four Worthington centrifugal pumping units, each delivering 15 mgd at 225-ft head, were installed in 1953 in the new Alexander Orr Jr Water Purification Plant at Miami, Florida. Constant threat of electrical failure during hurricane seasons called for diesel engines, rather than electric motors, as prime movers. Units selected were rated 825 hp at 450 rpm.

Water and sewers dept, which runs the plant, has adopted a series of daily and monthly report forms that give a continuous record of operations. Daily log sheet is kept for each engine. A daily maintenance report lists all normal and special work done. Total hours run, fuel and lube oil used and maintenance work performed are recorded on a monthly basis. At year's end, monthly logs are totaled and annual report prepared. Plant thus has an up-to-the-hour history of each pumping unit at all times charts, facing page.

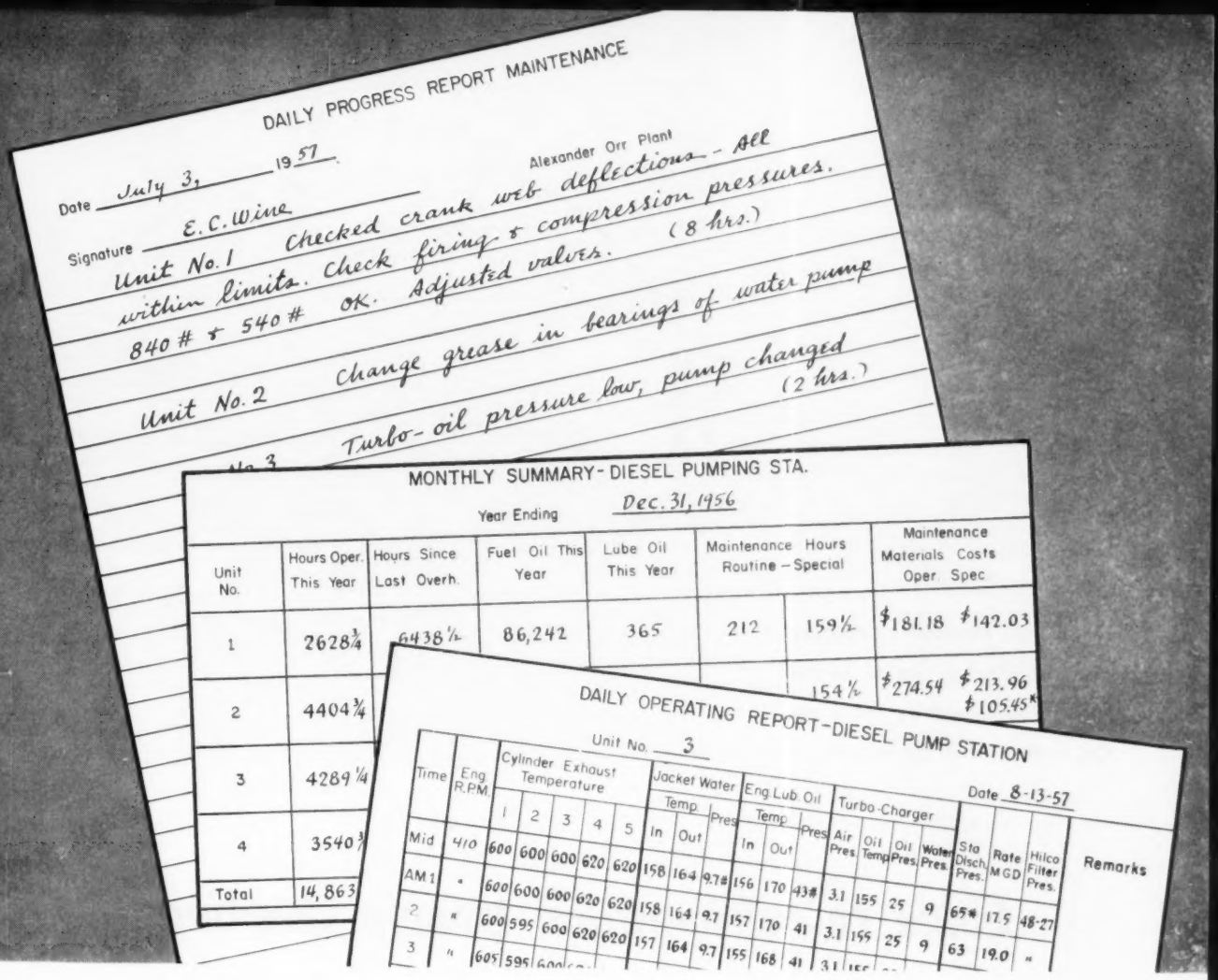
Lubrication is one reason for good results. Each engine has a full-flow oil filter, a by-pass oil filter and an edge-type oil filter. Cartridges are replaced in full-flow and by-pass filters whenever a 10-psi differential exists between inlet and outlet pressures. This happens at least once every three months and proves that filters are working effectively.

Despite all precautions, some fuel oil finds its way into the lube oil. Oil sample is taken from crankcase every week and tested for dilution. Oil is run through a reclaimer when dilution reaches 5% by volume. This occurs about four times a year. At present, reclaiming process takes about one week per engine. A reclaimer guaranteed to remove 5% dilution from lube oil flowing at 25 gph is being installed. It will do the job in less than a day.

Every 1000 hours, compression and firing pressures of each cylinder are taken with an indicator. Cards are then analyzed to determine condition of rings, valves and nozzle tips. Also, at the end of this period, crankcase doors are removed and crankshaft webs checked for deflection. While insurance firm allows deflection of 0.0045, we keep deflection within 0.001 in. Reason: it's easier to realign a crankshaft than to replace a broken one.

Every 90 days we change fuel-oil filter cartridges. Every 3000 hours the valve clearances are checked. At 6-month intervals we change the oil in turbochargers, air-intake filters, outboard bearings, and gear increasers. Automatic safety shutdown controls are also checked then. Since start-up, a soluble oil has successfully been used in the jacket water systems to reduce scale formation. But we have to flush systems with a slightly caustic solution to remove an oily sludge deposit at bottom of each cylinder jacket.

Diesel firms recommend complete servicing after 8000 hours. While nothing was wrong, we tore down one en-



DAILY PROGRESS REPORT MAINTENANCE

Date July 3, 1957 Alexander Orr Plant

Signature E. C. Wine

Unit No. 1 Checked crank web deflections - All within limits. Check firing & compression pressures. 840 # & 540 # OK. Adjusted valves. (8 hrs.)

Unit No. 2 Change grease in bearings of water pump

No. 3 Turbo-oil pressure low, pump changed (2 hrs.)

MONTHLY SUMMARY - DIESEL PUMPING STA.

Year Ending Dec. 31, 1956

Unit No.	Hours Oper. This Year	Hours Since Last Overh.	Fuel Oil This Year	Lube Oil This Year	Maintenance Hours Routine	Maintenance Hours Special	Maintenance Materials Costs Oper.	Maintenance Materials Costs Spec.
1	2628¾	6438½	86,242	365	212	159½	$181.18	$142.03
2	4404¾					154½	$274.54	$213.96
3	4289¼							$105.45*
4	3540¾							
Total	14,863							

DAILY OPERATING REPORT - DIESEL PUMP STATION

Unit No. 3 Date 8-13-57

Time	Eng. R.P.M.	Cylinder Exhaust Temperature 1	2	3	4	5	Jacket Water Temp In	Jacket Water Temp Out	Jacket Water Pres	Eng. Lub Oil Temp In	Eng. Lub Oil Temp Out	Eng. Lub Oil Pres	Turbo-Charger Air Pres	Turbo-Charger Oil Temp	Turbo-Charger Oil Pres	Turbo-Charger Water Pres	Sta. Disch. Pres.	Rate M GD	Hilco Filter Pres.	Remarks
Mid	410	600	600	600	620	620	158	164	9.7#	156	170	43#	3.1	155	25	9	65#	17.5	48-27	
AM 1	"	600	600	600	620	620	158	164	9.7	157	170	41	3.1	155	25	9	63	19.0	"	
2	"	600	595	600	620	620	157	164	9.7	155	168	41	3.1	155						
3	"	605	595	600																

gine at end of that period. Cylinder-lining wear was about 0.005 in. Bearings were perfect, so we re-installed them. Piston rings were in good shape, but we replaced them to avoid future shutdown. After valve seats were reseated and valves reground, engine was reassembled and put back on the line. On basis of what was found, we decided to keep engines running as long as cylinder compressions were good and lube-oil consumption stayed low.

As of this July, after 12,000 hours' operation on one engine, 10,000 on a second, 8000 on a third and 3200 since overhaul on the fourth, stack exhaust was barely noticeable. It is very important in our system that exhaust be as soot-free as possible. Reason: gases are washed in a scrubber, then bubbled through cooling water to reduce pH. Good maintenance has convinced us that diesel-operating costs can be kept low. At present time, a new 30 mgd pump is going in, which will be driven by a fifth diesel engine at 1500 hp.

Instruments for good diesel operation

1 Jacket water and lube-oil pressure and temperature gages

2 Low lube-oil and h-p jacket water alarms and shutdown controls

3 Turbo-oil l-p and cooling-water alarms and shutdown controls

4 Turbo-oil pressure and temperature gages

5 Overspeed trip

6 Engine-driven tachometer

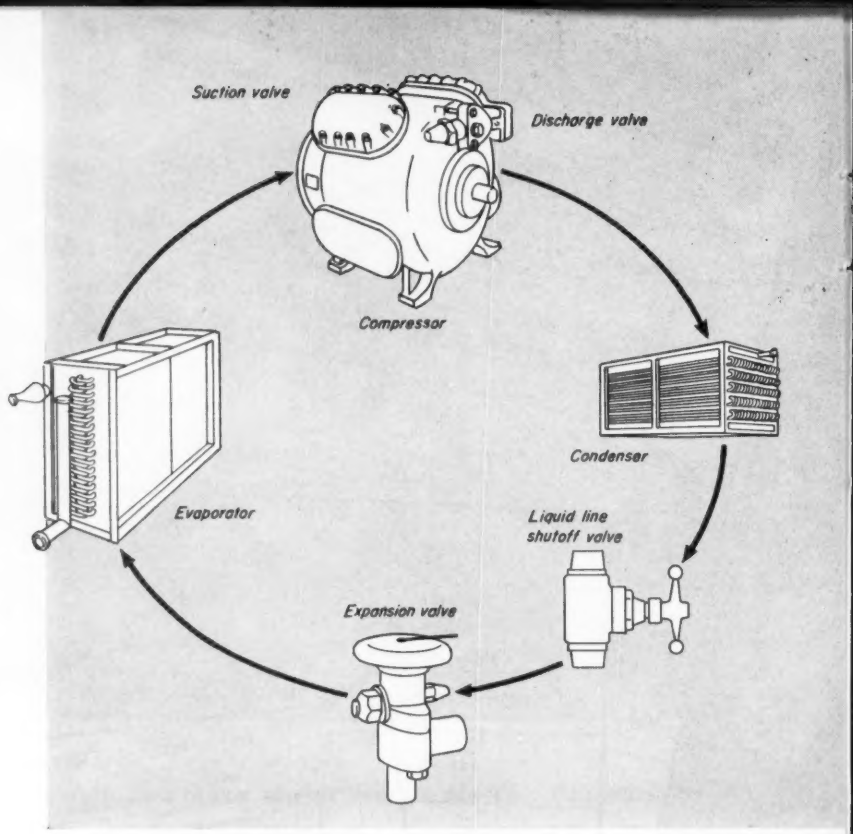
7 Thermocouples on each cylinder-exhaust elbow

8 Crankcase pressure gage

9 Deflection gage for crankweb reading

10 Firing and compression indicator

11 Temperature gage on jacket water outlet elbow of each cylinder for detection of dragging within the cylinder



Need to pinpoint refrigeration headaches in a hurry? Here, developed by the Trane Co, is first of a three-part . . .

Guide to refrigeration trouble shooting

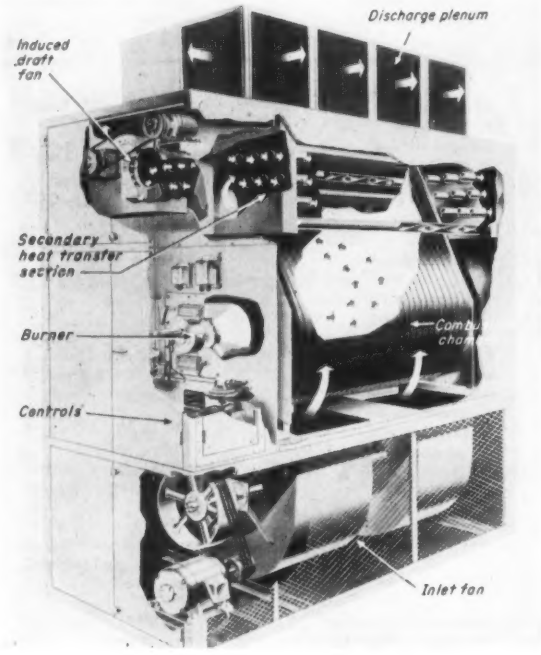
Trouble	Probable Cause	Symptoms	Recommended Action
A. Compressor fails to start	1. Power failure	1. Electric circuit test shows no current on line side of motor starter	1. Check for blown line fuse or broken lead
	2. Disconnect switch open	2. Electric circuit test shows no current on line side of motor starter	2. Determine why switch was opened. If everything OK, close switch
	3. Fuse blown	3. Electric circuit test shows current on line side but not on motor side of fuse	3. Replace fuse. Check load on motor
	4. Low voltage	4. Electric circuit tester glows but not at full brilliance	4. Check with voltmeter, then call power company
	5. Burned-out motor	5. Full voltage at motor terminals but motor will not run	5. Repair or replace
	6. Inoperative motor starter	6. Test for burned-out holding coil or broken contacts	6. Repair or replace
	7. Open control circuit a. dual pressure control b. oil failure control c. motor starter thermal overloads d. thermostat not set for cooling e. open circuit from "interlocking" relays	7. Motor starter holding coil is not energized	7. Locate open control and determine cause. See individual control instructions
	8. Broken or sheared coupling	8. Motor runs but compressor does not	8. Repair or replace. Properly realign

Trouble	Probable Cause	Symptoms	Recommended Action
	9. Frozen compressor due to locked or damaged mechanism	9. Compressor will not operate	9. Overhaul compressor
	10. Suction pressure below cut-in setting of low pressure cut-out switch	10. Open contacts on low-pressure switch. Suction pressure below cut-in setting	10. Check for loss of refrigerant. Repair leak and recharge
	11. Discharge pressure above cut-in setting of high pressure cut-out switch	11. Open contacts on high-pressure switch. Discharge pressure above cut-in setting	11. See trouble G (part 2 of guide)
	12. Oil pressure failure control switch has cut-out	12. System will restart by resetting oil pressure failure control switch	12. Check oil level, oil pressure, wiring and control for faulty control
B. Compressor "short cycles"	1. Intermittent contact in electrical control circuit	1. Normal operation except too frequent stopping and starting	1. Repair or replace faulty electrical control
	2. Low-pressure controller differential set too close	2. Normal operation except too frequent stopping and starting	2. Reset differential in accordance with proper job conditions
	3. Leaky liquid line solenoid valve	3. Valve may hiss when closed. Also temperature change in refrigerant line through valve	3. Repair or replace
	4. Dirty or iced evaporator	4. Reduced air flow a. dirty air filters b. broken fan belt c. fan belt tension improperly adjusted	4. Clean or defrost evaporator. Check filters and fan drive
	5. Faulty condensing	5. Excessively high discharge pressure	5. Check for water failure or evaporative condenser trouble
	6. Overcharge of refrigerant or non-condensible gas	6. High discharge pressure	6. Remove excess refrigerant or purge non-condensible gas
	7. Lack of refrigerant	7. Normal operation except too frequent stopping and starting on low-pressure control switch	7. Repair refrigerant leak and recharge
	8. Water regulating valve inoperative or restricted by dirt, or water temperature too high	8. High discharge pressure	8. Clean or repair water valve
	9. Water piping restricted or supply water pressure too low	9. High discharge pressure	9. Determine cause and correct
	10. Restricted liquid line strainer	10. Suction pressure too low and frosting at strainer	10. Clean strainer
	11. Faulty motor	11. Motor starts and stops rapidly	11. Repair or replace faulty motor
	12. Fouled shell-and-tube condenser	12. Compressor cuts off on high-pressure cut-out	12. Clean condenser tubes
	13. Faulty operation of evaporative condenser	13. Compressor cuts off on high-pressure cut-out a. no water b. spray nozzles clogged c. water pump not operating d. coil surface dirty e. air inlet or outlet obstructed f. fan not operating	13. a. fill with water b. clean spray nozzles c. repair faulty pump d. clean coil e. remove obstruction f. repair

OPERATORS' NOTEBOOK 113

Let's take a look at

How heater works



► YOU MAY NEED HEAT in a space where steam or hot water isn't available; or where it would be troublesome or uneconomical to pipe in a supply. Answer lies in separately fired unit heaters. These range from small gas-fired propeller-fan types to large centrifugal-blower designs having outputs of 400,000 to 2,000,000 Btu per hr, or more. Heated air discharges directly through heater-mounted nozzles or into a duct distribution system.

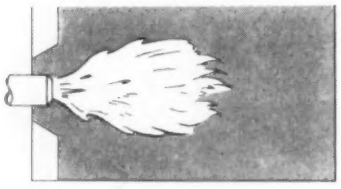
In unit shown, oil or gas is fired directly into combustion chamber having no refractory lining. Steel is 16 gage or more, all welded, type 430 stainless. Pressure relief door and observation ports are in rear. This chamber is shaped like wing section of airplane. Top, or trailing edge, encloses angle of about 51 deg. Rounded bottom resembles leading edge of wing. This airfoil design permits maximum flow of air with minimum resistance, causes most heat-transfer areas of chamber surface to be wiped by air stream.

Flame travels length of chamber, sweeps upward and back to exhaust port above burner opening. Gas then travels through series of corrosion-resistant aluminized-steel economizer tubes, which comprise the secondary heat-transfer section. These tubes are nested along both sides of chamber directly in air steam. Gas then travels to back of heater along righthand side of chamber, returning to front through tubes on left of chamber. Economizer tubes are fitted with twisted metal swirlers that spin the gas to achieve more effective heat transfer to air stream.

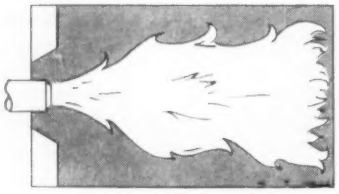
Separately driven i-d fan at tip front of heater pulls out all combustion in exhaust gas. This provides positive purge period before ignition and purge following burner shutoff.

—Courtesy, Dravo Corp, Pittsburgh, Pa.

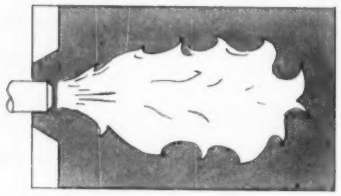
Gas analysis and flame are important



Flame too short



Flame too large



Proper flame

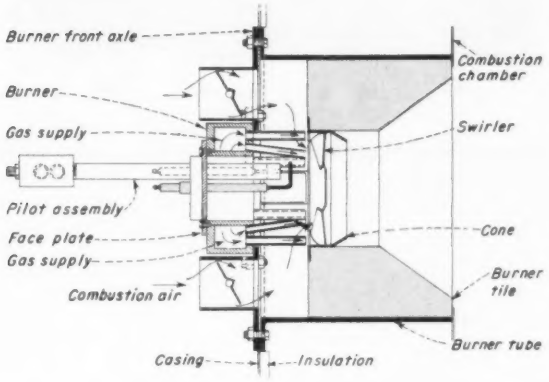
Temperature and CO_2 content of flue gas are best measure of combustion efficiency. They also set up a guide for correct setting of combustion air dampers. Oil-fired models are set for 10 to 11% CO_2; gas-fired models for 8 to 9% CO_2. Stack temperature should be around 550 F, and, of course, high CO_2 indicates too little combustion air volume. High stack temperature is usually caused by overfiring.

Flame travel. Make sure flame is fairly vigorous, and free of smoky haze. It should barely impinge on rear wall. Never adjust your burner to give a short bushy flame concentrated in burner end of chamber. Such a pattern short circuits between burner and exhaust port. Then high stack temperature overheats metal surfaces. Make sure flame is steady and long, as in sketch, for full two-pass travel. Then it has enough time for complete combustion and balanced heat is released.

separately fired space heaters

By STEVE ELONKA, *Associate Editor*

Here's your gas-oil burner



Mechanical induced-draft burner uses ring and finger design. Gas ports and oil nozzles for instant switchover from gas-to-oil or oil-to-gas are arranged so flame from one cannot affect operation of other. This is important.

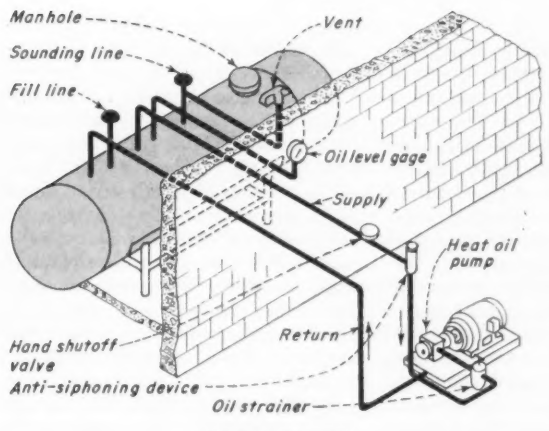
For firing heavier and less expensive No. 5 oil, burner has an air atomization and dual preheating system. This provides hot oil at nozzle before burner attempts to light off. Heavier No. 5 oils must be brought to a higher temperature than lighter oils to assure dependable starts with electric spark ignition. Once flame is established, operations continue with lower oil temperatures. Dual preheater system provides these conditions in about 60 seconds after thermostat calls for heat.

Induced-draft fan, with adjustable sheave drive, pulls combustion air into burner and also exhausts spent gas to stack. Electronic burner safety control system gives two positive purge periods to remove fumes and gas in combustion chamber. Exhauster fan operates for 30 seconds before burner can start, and 30 seconds after burner shutoff.

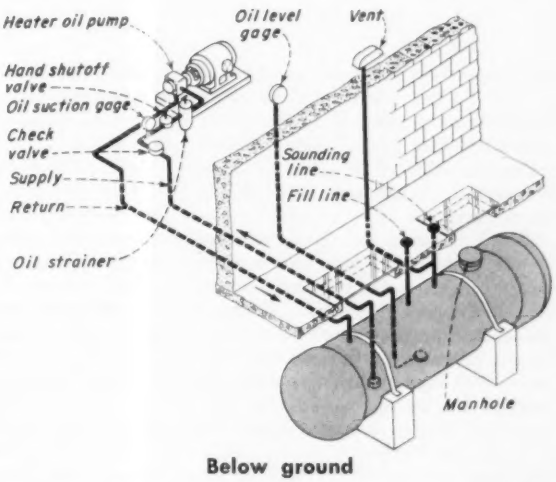
Fuel changeover takes only 30 seconds. You have no manual exchange of burner, piping, or controls; just flip a manual selector switch that's mounted in the control cabinet.

High negative pressure in furnace is about 5 in. water gage at start-up and from 1- to 2-in. during operation. Why high negative pressure? It greatly minimizes chances of puff backs at burner caused by possible delayed ignition at start-up. Also, you don't need heavy boiler-type pressure relief doors—all of which simplifies the unit.

Know your oil tank hookup



Above ground

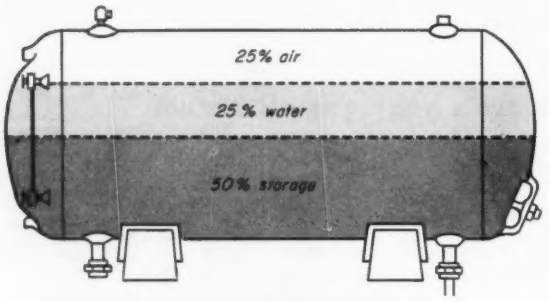


Below ground

Always place fuel-oil tanks handy for filling from tank cars or trucks. Of course, nearer tanks are to space heaters, less your piping costs. Also check local safety codes.

Above ground or under ground. From a heater maintenance angle, buried tank is preferred. Raised tanks subject the oil to variations in temperature and viscosity. These variations may necessitate frequent burner adjustment.

Raised tanks must have following clearances from buildings: 5 ft for 750 gal or less, 10 ft for 1100 gal; 20 ft for 3000 gal; and 25 ft for 21,000 gal. Minimum distance between tanks must be 3 ft for 18,000 gal or less and 5 ft for 24,000 gal. Fuel pump will lift 15 ft with maximum horizontal run of 100 ft. Two sketches show recommended hookup for tanks for trouble-free service.



STORAGE MISCONCEPTION involving air-water ratios above is due to holdover of principles applying to elevated tanks

Don't let wrong air-water ratios keep you from getting good . . .

Pressure tank system control

By R G SCHLETTY, *Applications Engineer, Automatic Control Co.*

► PRESSURE TANKS are common in commercial and industrial-plant water-distribution systems. However, it's a safe guess that few of these pressure tanks are adjusted to give the most satisfactory results and most efficient pump operation.

The big reason for this is the operators' assumption that after a given pressure drop, water remaining in the tank is reserve. They don't ask themselves, "at what pressure?" Too often the air pressure for this so-called "reserve" isn't high enough to push water very far into the system. Consequently, water left in the tank is useless.

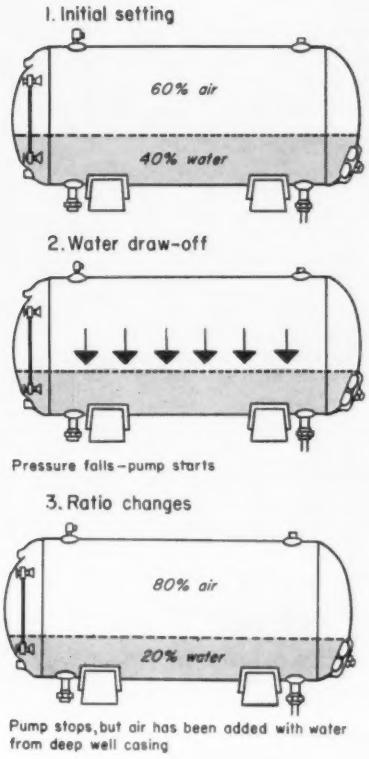
If you stop to think about it, a pressure tank isn't a storage tank at all. Its purpose is to boost to a higher-pressure water taken from a lower-pressure source. Too, it may be used to stabilize a varying-pressure condition and hold a new pressure limit above and below which water pressure won't fluctuate. The tank is to hold pressure within a definite range and it's usually small enough so relatively short-time pump operation will fill it to capacity.

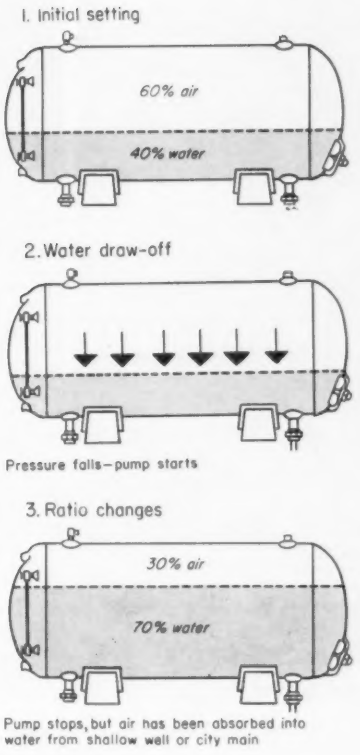
Let's go back for a moment and see how the pressure tank came into the picture. First, a piece of pipe charged with air was used to eliminate water hammer. This, in turn, led to use of "surge" tanks. Realization that the surge tank was, in reality, a new water-supply scheme created a truth and a lie. It was true that surge tanks could boost distribution-system pressures. But it was *not* true that these tanks would provide water storage. Application of both the truth and the falsehood caused pressure-tank abuse but, actually, the abuse contributed to the end development. System pressures were stabilized within certain limits, using surge tanks. But nobody considered pump cycling, tank size and proper pressure limits. Further, no consideration was given to the costs involved, the water value and the proportionate tank value to contained water.

This mistaken application of pressure tanks was a carryover from elevated-tank principles. Pressure-tank users were thinking in terms of tanks being worth so many dollars per ft volume, as in the case of elevated tanks. It wasn't any secret that an air-and-water combination in an air-tight vessel would force water into the system by exerting air pressure on it. But the proper air-water ratio wasn't determined and the dollar value of air volume was neglected.

Storage misconception lingered and some interesting percentage ratios popped up, through modification of the elevated-tank principle. It was decided that 50% would be OK for storage and the remaining 50% could be split—25% water, 25% air—which added up to a total of ¾ water, ¼ air in the tank.

Tanks became waterlogged, but this





Hazards of pressure control alone

Manually draining tank, recharging with air wastes power and pumped-up water

Production can suffer when an outlet delivers a blast of air instead of water

was repeatedly "remedied" by the old-fashioned way of manually draining the tank and recharging it with air. There wasn't much thought connected with the waste of valuable pumped-up water and dollars were virtually spilled down the drain. Or, going to the other extreme, air-bound surge tanks resulted from air being drawn in each time water was added. This condition wasn't detected until someone opened a valve or tap and got a blast of air instead of water. But manpower was cheap and water was plentiful, so little effort was spent on doing it a better way.

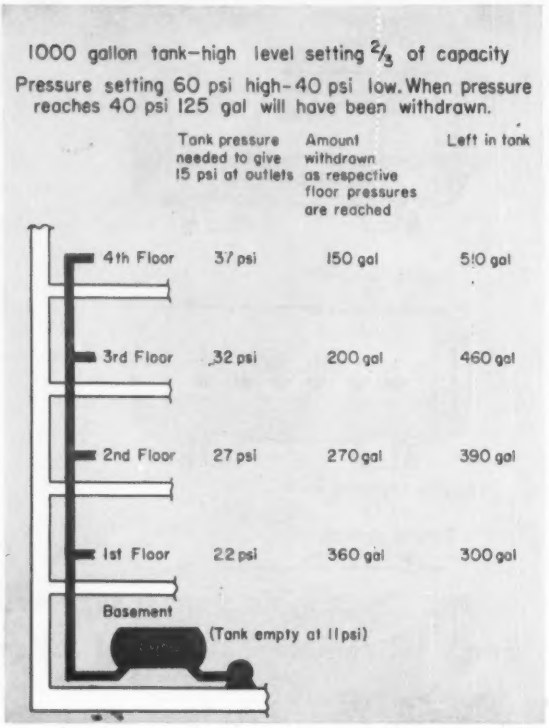
Overlooked entirely during all these goings on was Boyle's Law which states that temperature being constant, volume of a given mass of gas varies inversely as absolute pressure—or $P_1/P_2 = V_2/V_1$. In everyday language, with 1 in. of air in a tank, withdrawing 1 in. of water doubles the air space. V_1 makes a big change to become V_2 and pressure changes correspondingly. However, if the air originally occupies a large space, drawing off a few gallons of water causes only a relatively small increase in air space and a fairly small decrease in pressure.

By 1947 the significance of Boyle's Law to pressure-tank application was realized by three completely independent company analyses, and all three reached basically the same conclusion. The sole use of a pressure tank is to boost stabilized pressure, and since the tank functions only between certain pressure limits, its purpose is not, and cannot be, storage.

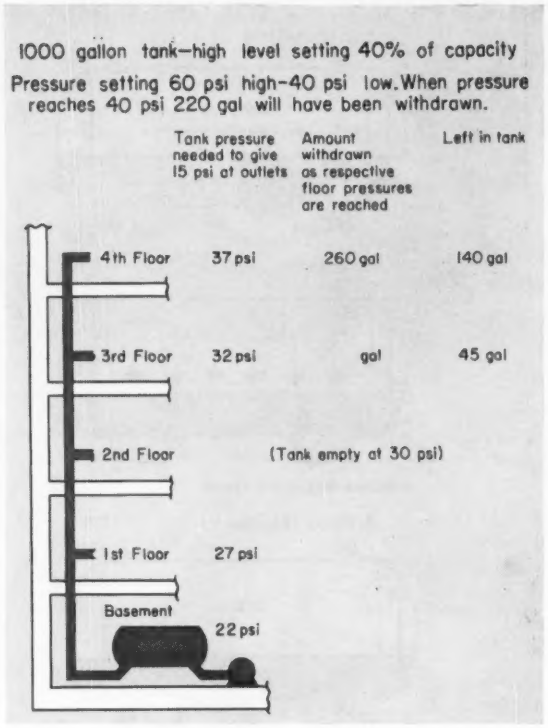
Other new conceptions arose at the same time. Boyle's Law, properly applied, showed conclusively the error of the ¾ water, ¼ air ratio. Manual operation and tank draining went out the window. Dual controls were developed to ride herd on both air and water and maintain the all-important air-water ratio. Efficient and economically sized tanks came into being, and all available water was used each and every time.

Despite these developments, a great many of today's pressure tank systems aren't operating with the proper air cushion and water level (air-water ratio) in the tank. A common theory used is the rule-of-thumb method which calls for 2/3 water and 1/3 air. This ratio *must* result in unecessarily frequent pump operation and undesirably fast pressure drops after only a small amount of water has been used. It can't be emphasized too strongly that more water in the tank does *not* mean there will be more water available *at the necessary pressure* to service the entire system.

To illustrate the point that water remaining after a given pressure drop can't be used as reserve, let's consider a four-story building with a 1000-gal hydro-pneumatic pressure tank in the basement, Fig 1, p 120. The tank's job is to boost well-water supply to a satis-



1 Commonly used rule-of-thumb theory of 2/3 water, 1/3 air ratio gives too-fast pump cycle, unwanted pressure drop



2 Less water in tank, same air pressure, ups water available per lb of air-pressure drop, cuts number of pump cycles

factory pressure, let's say 15 psi, to service outlets on all floors. To furnish this pressure on the fourth floor, tank pressure will have to be 37 psi. The 1000-gal tank is 2/3 full and pump controls are set to cut in at 40 psi and out at 60 psi air pressure.

Let's see what happens when we use the water. By the time we've drawn 125 of the 660 gal, our tank pressure has dropped to 40 psi, but we still have a so-called "reserve" of 535 gal. Is this really reserve—that is, reserve that can be fully used if demand increases or the pump fails to start, and pressure continues to drop below 40 psi? Fig 1 shows that we can only use 25 gal more, (150 total), before pressure drops to barely enough for the fourth floor. If we withdraw another 50 gal, (200 total), only the first three floors can get water. If we take 100 gal more, we have a so-called "reserve" of 360 gal in the tank. But now the pressure is down to 25 psi, which is just enough to feed the first floor. So what is thought of as "reserve" isn't reserve at all because it isn't at sufficient pressure to meet demands. Our example shows that there are always several hundred gal in the tank that serve no useful purpose at all due to *lack of pressure.*

Consider the pumping situation. Suppose we have a 100-gpm pump with this tank, and a maximum consumption of 50 gpm over long periods. When we draw the first 125 gal and pressure drops from 60 to 40 psi, our pump must run for 2½ min. It's delivering 100 gpm but half of this goes to meet the 50 gpm demand, the other half to build up the tank supply. Then the pump stops. 2½ min later it must start again, run for another 2½ min. Each pumping cycle takes 5 min, or 12 cycles per hr. Each start takes 5 to 10 times ordinary operating current. Added to this cost, there's the increased wear and tear on equipment. To put it mildly, it's uneconomical.

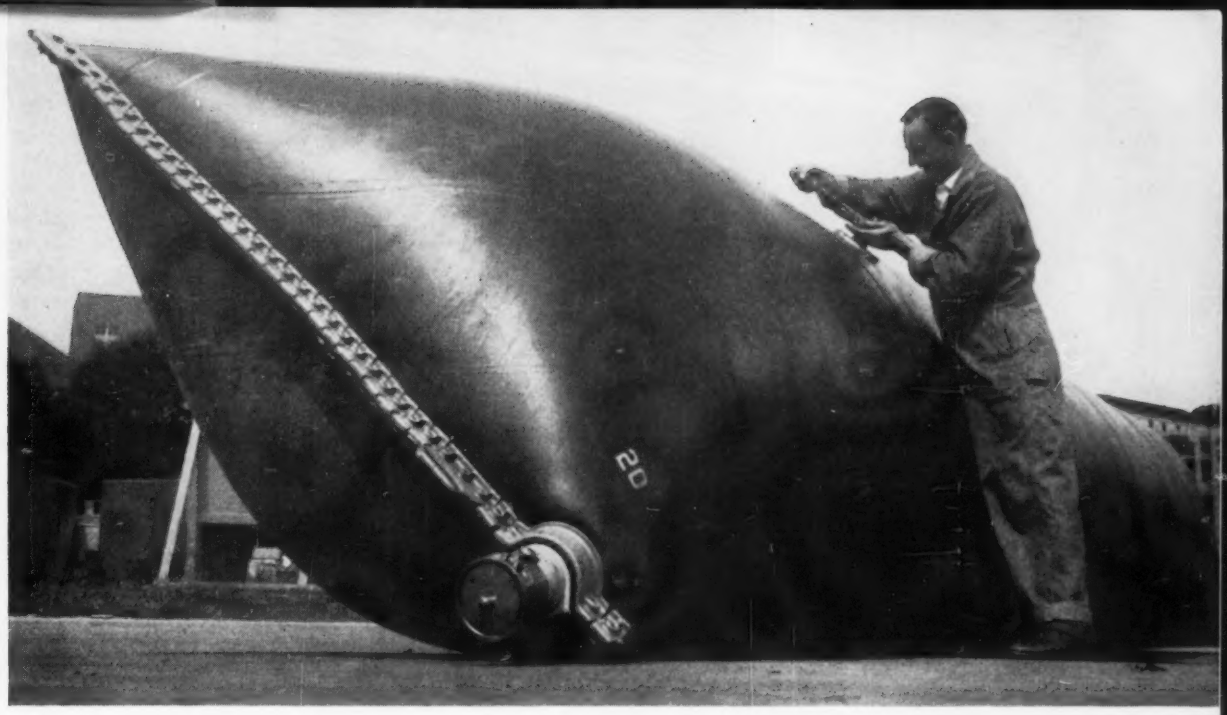
How do we correct the situation? Very simply. First, consider what happens when a tank is filled to within 1-in. of the top. Little water can be used before pressure drops to zero, because we didn't have much air in the first place. Now consider the same tank with just a few in. of water in it. We can withdraw practically all the water with very little pressure drop.

Let's go back to our four-story building, Fig. 2, above. This time we'll fill the tank only 40% full, or 400 gal. We'll use the same pump cut-in and cut-out points. Now we can use 220 gal before the pump starts. Compare this with the 125 gal in Fig. 1.

It takes 4.4 minutes (at 50 gpm) before our pump starts and it'll run for another 4.4 minutes to build up the supply to the original 400 gal. Pumping cycle is 8.8 min, or about 7 cycles per hr, much less than the 2/3 ratio.

Formulas are easily available for finding proper air-water ratios for any size tank and operating conditions. Tank's type or shape doesn't matter because Boyle's law doesn't care about the shape of the volume. The only way shape is important is in determining actual measurement of high-level setting and number of in. to be left in the tank as a seal over the outlet.

Tank efficiency can be improved, as we've seen, by controlling water level with the original charge of air. If we go a step further and control both water and air level, the tank system can be made to operate nearly perfectly. With such controls, system permits a greater withdrawal with little pressure drop. With more water available on each pumping cycle, it naturally follows that fewer cycles are needed per hour, and fewer pump operations must give lowered operating cost.



Rubber tanks: a new way to store oil?

► INDUSTRY'S chronic liquid- and oil-storage headaches may soon be cured by a giant rubber-fabric container that looks like an overgrown toothpaste tube. Called the *Sealdtank*, it is a recent development of the U.S. Rubber Company.

The tank requires no maintenance and provides maximum flexibility since it can be moved from place to place.

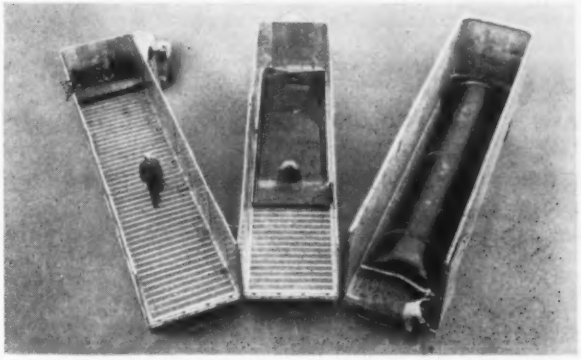
Construction. The tank is made of four plies of rubber-coated rayon tire fabric, molded similar to a tire. Ends are sealed by metal closures resembling spinal columns. Tank's outer surface is made of neoprene for oil and weather resistance. Inner surface can be made of a variety of special rubber compounds, depending on intended use.

Applications. Although the tank was designed primarily to handle liquids in transit, it seems destined to find an important spot in industry as a low-cost storage vessel. It's adaptable to highly corrosive chemicals which often require special alloy or rubber-lined metal tanks. And, it will be given a long, hard look by industrial plants concerned with storage of fuel and lube oils.

In multistory plants the tank can be rolled up and brought to any floor or the building's roof by elevator. It eliminates costly building alterations sometimes necessary with installation of metal tanks. Floor loading is no problem because its long contact surface distributes weight over a large area.

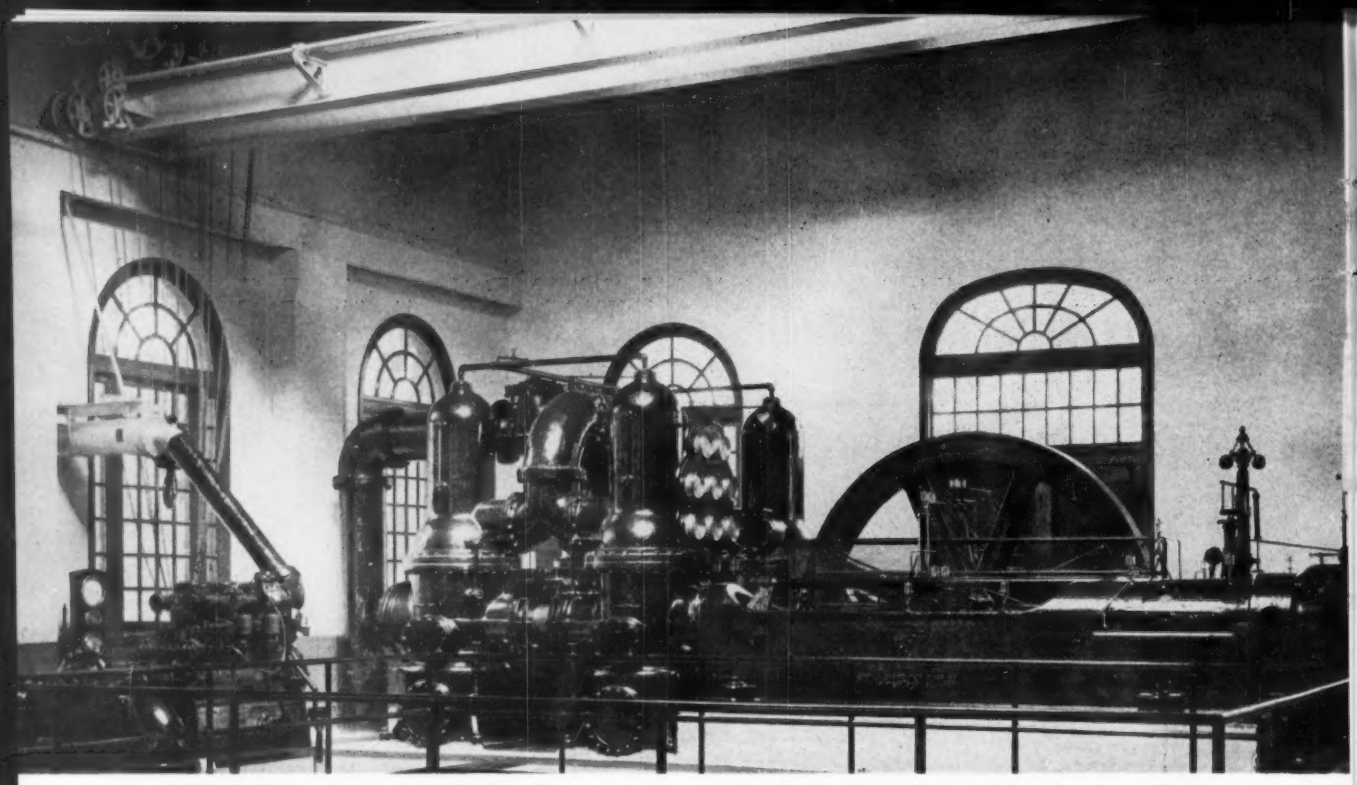
A 3800-gal container, designed for the trucking industry, is in production. For industrial plant storage the company plans to manufacture tanks with capacities from 10,000 to 20,000 gal.

Another approach. Scrambling for the loose ball in the oil-storage market, the aluminum industry has recently started to produce aluminum cans for this purpose. Other industries will also vie in an attempt to find a more economical and flexible means of storing liquids and industrial oils.



Dry, liquid 2-way haul in same truck

Three basic steps convert trailer truck for dry haul in one direction to liquid load on return trip. Rubber tank in truck *left* is rolled into cylindrical package. After removal of dry cargo it is unrolled *center* and filled with liquid for return trip *right*

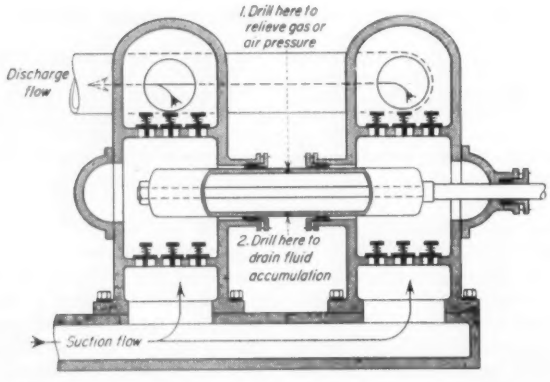


INNOCENT LOOKING, but men have been seriously hurt when trying to take outside-packed plungers of these pumps apart

Hollow plungers are dynamite

- **Why does pressure accumulate in pump's plungers?**
- **How does highly flammable gas build up in plungers?**
- **These, other questions are answered for your safety**

By **JOHN B MURPHY**
American Water Works Service Co, Inc



FIRST, relieve pressure from this piston by drilling at top. But make sure you stand clear of the electric drill

► WE DRILLED A PLUNGER at one of our plants recently. As soon as the drill broke through the plunger wall, a tremendous flame shot out. The mechanic suffered first-, second- and third-degree burns, was hospitalized for weeks. This violent flame was 15 to 18 feet in length. Our man was lucky to be alive.

Precaution. Since this experience was new to us, we just couldn't account for the flammable gas inside the plunger. So I supervised the drilling of the second plunger personally. Drill was erected with extension handles so it could be done from a distance of 12 to 15 feet, and at right angles to the hole being drilled. Drill switch was locked in a closed position; power

could be disconnected by pulling a remote extension plug. As an added precaution we passed a stream of water over the drill bit throughout the drilling operation. It's doubtful if this was of much value, since, given a spark, the gas would still have ignited. But ignition did not occur this time.

Since we were searching for a cause, we didn't wait for pressure to be entirely dissipated before removing the drill. After several minutes, when pressure dropped to a somewhat safer level, I removed the drill. Then I attempted to hold pressure in the plunger by placing my thumb over the small 5/16-in. hole. There was so much pressure that 10 minutes passed before I could hold the gas with my thumb. Next, I ignited the gas.

Gas burned with an absolutely clear blue flame—as near to perfection as that produced by a bunsen burner. Flame was 2 feet in length, burned for 7 to 8 minutes. Gas was clear with a faint odor typical of methane or natural gas. I have drilled many such plungers and in every case I've observed a similar odor. I'm convinced that gas accumulation isn't unusual, but a normal condition.

Maintenance men must keep this hazard in mind, even though they have no intention of drilling pump plungers in the immediate future. At no time should a plunger be removed without first relieving the accumulated pressure. This is especially important if the equipment is being removed permanently. It's common practice to contract such removal work to wreckers or other outside concerns. Danger is from pump first being dismantled with cutting torches. Hazard is obvious; accidental ignition of a closed high-pressure cylinder of gas could explode, wrecking your plant, injuring or killing personnel.

If you use an electric drill, there's always the chance of ignition from the motor brushes. If you must drill, erect the drill and hold it in place mechanically. Apply pressure through leverage, so no one is closer than 15 feet from the drill, and at right angles to hole being drilled. It's best to drill with an air motor. While possibility of drill bit overheating and causing ignition is remote, the danger can be eliminated by flushing the drill continuously with water.

Don't remove equipment until pressure is entirely dissipated and area thoroughly ventilated. Remember, plunger or vessel will still contain some gas at atmospheric pressure. When disassembling the equipment further, guard against ignition of residual gas. After removing rods or end plates, blow out the plunger with air. This flushes out any remaining gas.

By strictly following these instructions, you can prevent a severe accident. Your pump need not be similar to ours; any hollow plunger working in water is undoubtedly gas filled. So supervisors should see that all personnel is informed. I suggest that all plants having plunger pumps post this information on their bulletin boards.

Remember, the type of fluid being handled has no bearing on the problem. Our pump was handling filtered, treated, clear water. As yet, we don't know the exact source of the gas, but believe that it resulted from organic decomposition of elements existing in all water; or it may have been caused by traces of greases or oils that were present within the cylinder or plunger.

If you know of any other industry using this type equipment in your city, as a public service, why don't you inform them of this hazard?

Do you know that all closed plungers operating in a fluid often build up internal pressures of 50% above pump's discharge pressure? This is caused by water hammer or ram effect at the instant of stroke reversal. No matter how tightly the built-up plunger is sealed by gaskets, etc, pressure may accumulate. Besides pressure, you often find water that causes the machine to knock. Many cracker-jack operators have gone screwy trying to locate the cause of such a knock. Reason: knock is transmitted to all bearings throughout the machine. So you look everyplace but where it comes from.

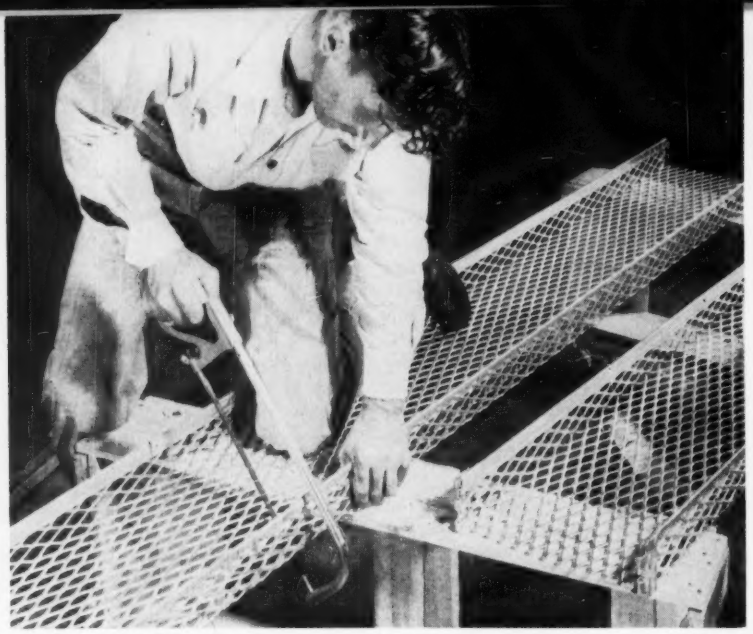
To relieve pressure and drain water, it has long been a common practice to drill a hole in bottom of plungers, sketch, facing page. Hole is tapped and plugged with a brass plug, then filed smooth. When removing a plunger, you should first relieve pressure in this way. Otherwise, plunger parts are apt to be blown violently apart as soon as you remove the rod nuts.

I always assumed that air accumulation caused the pressure. It has been our practice to drill two holes, one at or near top of plunger to relieve gas pressure, a second at bottom to drain accumulated water, sketch, facing page.

EDITOR'S NOTE: John Murphy's experience is highly interesting. Have any of you readers had a similar experience with gas inside hollow plungers? Or with gas inside plungers working with fluids other than water? Do you know the exact cause of pressure and gas accumulation? Send me your theories. Your letters should make a second fact-filled article.—STEVE ELONKA.

"Do you realize how atomic power will simplify things?"

BRACKETS are easily inserted into upright wall strip at any height desired



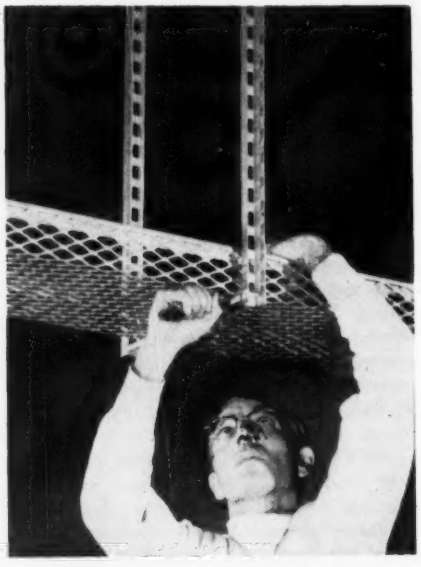
CUT SHORT SECTIONS to fit. Interlocking-barrel end assemblies are available to replace factory-welded ends of standard sections. Expanded metal cuts readily

It's easy to install cable trough

► IF YOU'RE WONDERING how big a job it is to install cable trough, these photos will give you a good idea of how much work is involved when it's done correctly. Today, there are fittings and special sections available to meet almost any routing requirement. Advantages of cable trough don't end when it's installed; additional cables can be put in easily, and installed cables can be replaced and rerouted if system changes demand it.

—Photos courtesy of T J Cope, Inc

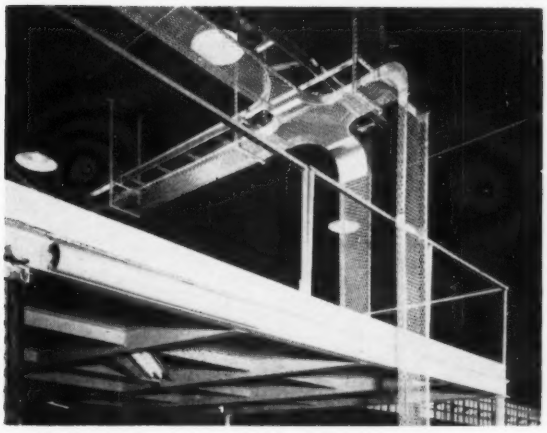
TRAPEZE SUPPORTS are attached to ceilings Interlocking horizontal members are inserted



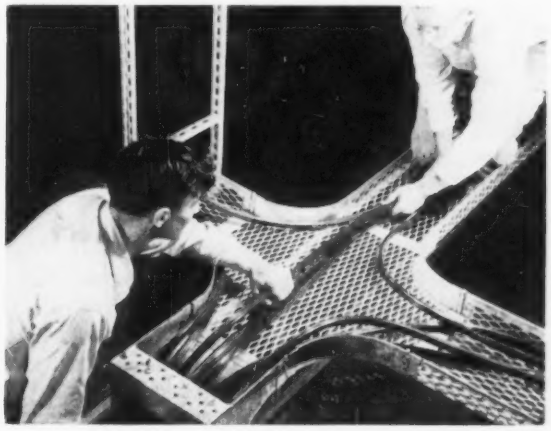
SUSPENDED TROUGH is bolted to horizontals and coupled at ends to provide continuous runs

BOLT, NUT AND WASHER combination, specially designed for fastening cable trough, speeds assembly. Use parts specified by manufacturer to avoid lost time

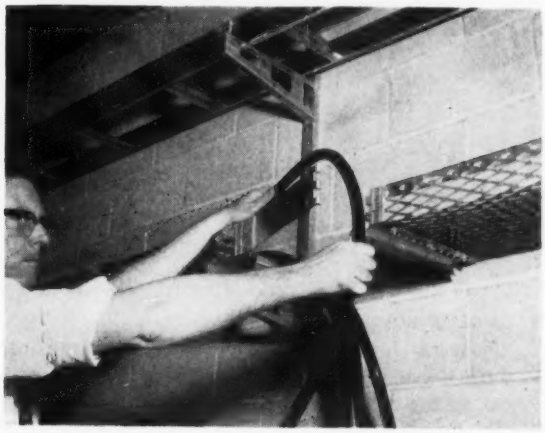
FASTEN JOINTS quickly with pin-type coupler. Drive pin into interlocking ends



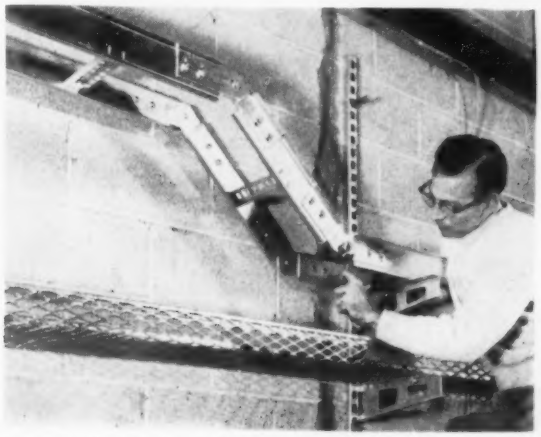
CABLE DROPS from four-trough intersection suspended above platform show adaptability of trough to variety of locations



LIGHTWEIGHT BUT STRONG, trough installation can support heavy loads. Laying cables in troughs is a simple operation



HINGED SECTION permits many installation short cuts, can be recoupled in seconds. Note smooth flanges where cable drops



INTERCHANGEABILITY of trough, ladder simplifies additions to system. Ladder is suited for interlocked armored cable

Plant

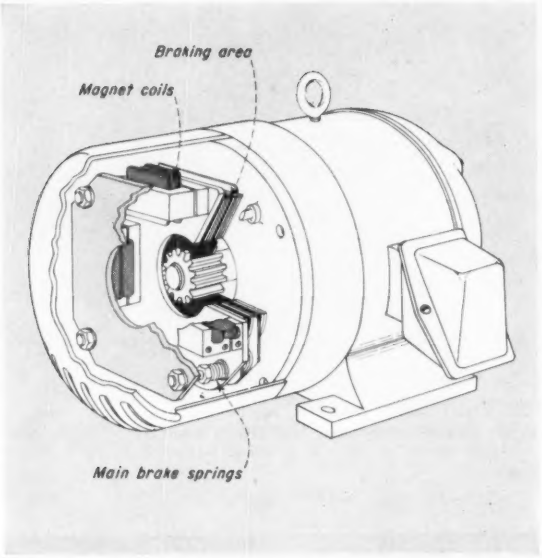
Electrical Fact File

No. 19: BRAKES

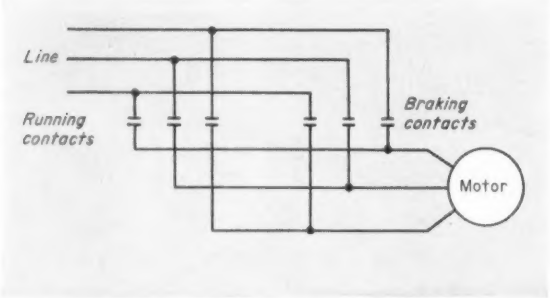
7 ways to brake electric motors

By **NORMAN PEACH**, *Assistant Editor*

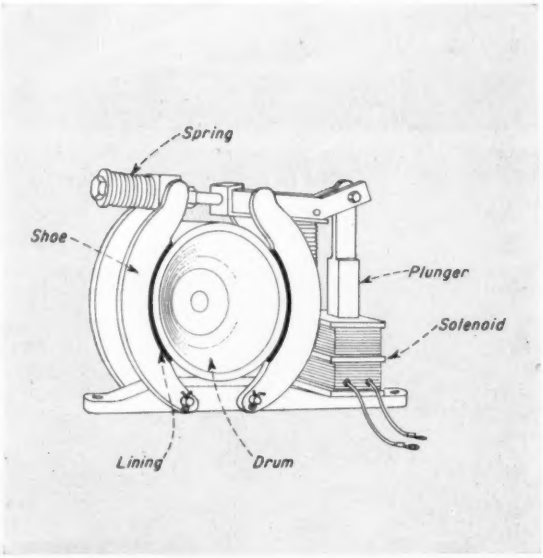
► ELECTRIC MOTORS often drive loads which have to be decelerated, stopped and held in a particular way. Other types of loads, such as cranes, may have to be held from running away. Various braking methods have characteristics that can be matched to behavior of the load. Here are seven electrically operated brakes and internal motor-braking arrangements.



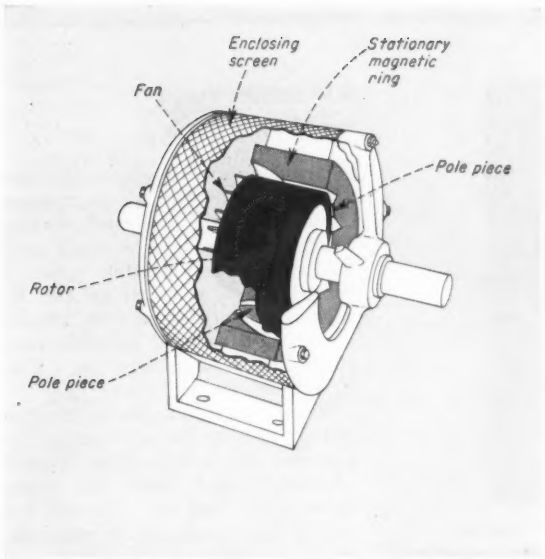
2 **DISK BRAKE** built into motor frame is best method on many jobs where quick, frequent stops are necessary. Brake holds load after stopping it. If power fails, load is stopped and held. Integral brake is often used on gear-reducer motor for conveyors and similar drives. In most designs brake can be adjusted or repaired without dismantling motor. Brakes are also available on dc motors.



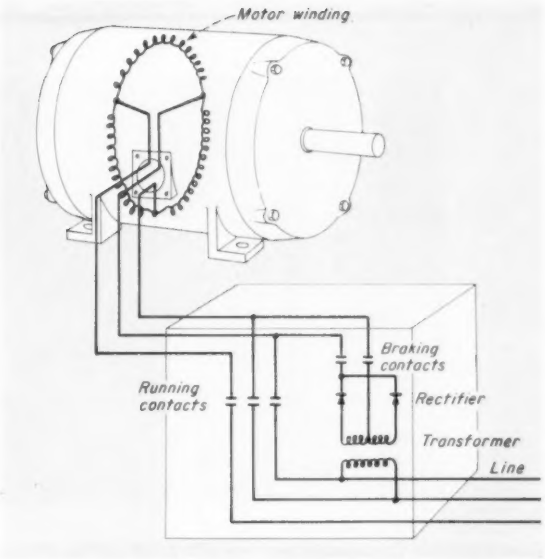
1 **PLUGGING** is application of countertorque to decelerate load by reversing motor connections. Detailed controller hookup was given in *Fact File* No. 16, July 1957. Plugging brings speed to zero quickly in most cases. Resistors may be used where smooth deceleration is desired. Note that power must be disconnected at zero speed or motor will accelerate in opposite direction and might do damage.



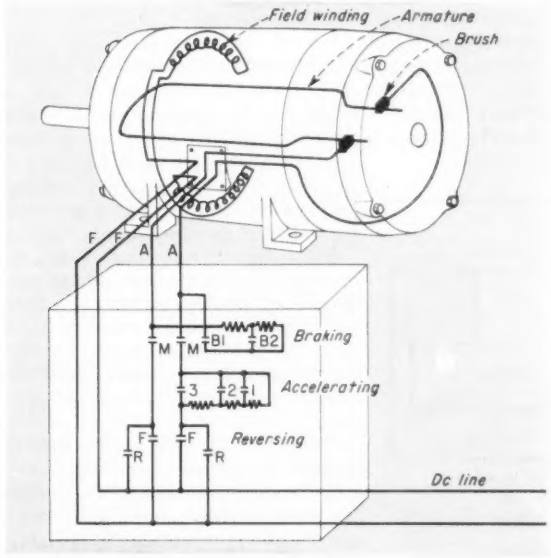
3 **SHOE BRAKE** is standby where holding heavy loads is important. It's often used in conjunction with dynamic braking for final deceleration, stopping and holding. Widely used on cranes and elevators, the brake is set by spring, released by solenoid and plunger or a hydraulic mechanism actuated by small electric motor. Like disk brake, shoe brake stops and holds load on power failure.



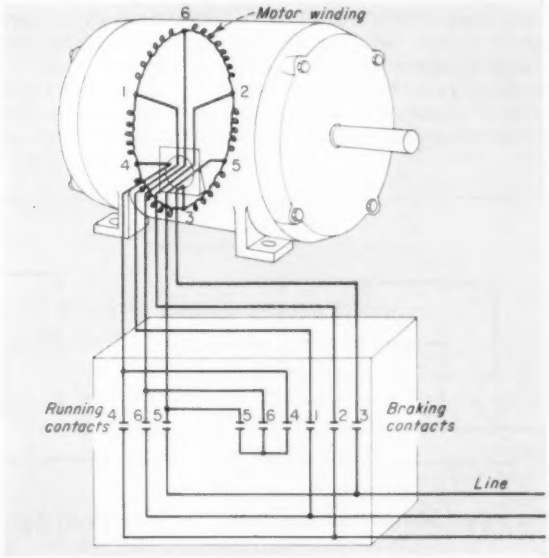
4 **EDDY-CURRENT BRAKE** can be coupled between motor and load similar to clutch. In type above, stationary ring is strong permanent magnet having several distinct poles on its inner surface. Rotating member behaves like induction motor's rotor. Eddy currents induced in it produce field which reacts with stationary field. Brake decelerates, restrains, but won't hold load at zero speed.



6 **AC MOTOR DYNAMIC BRAKING** can be done in several ways. One method is to energize one phase of motor winding with dc from small rectifier. Braking action is like eddy-current clutch. Another method connects single-phase power between one motor lead and other two; unbalanced field causes braking. Still other schemes employ capacitors, or capacitor and resistors instead of rectifiers.

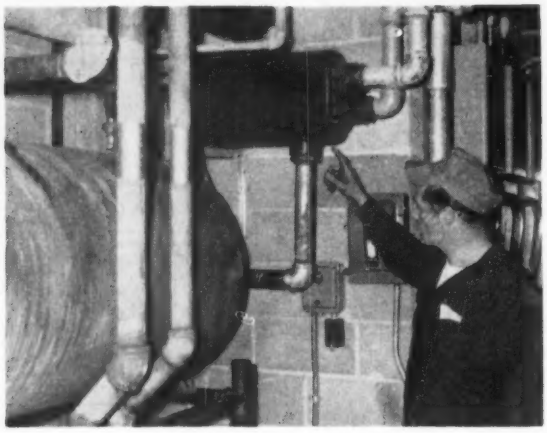


5 **DC MOTOR DYNAMIC BRAKING** is often used to decelerate or restrain high-inertia loads. In shunt-motor scheme above, field remains connected. While running, forward contacts *F, F* or reverse *R, R*, and motoring contacts *M, M* are closed. Contacts *1, 2, 3*, close in succession when starting. Contacts *B1, B2* are open. When braking, all contacts open; *B1* closes, and later *B2*. Motor generates.



7 **REGENERATIVE BRAKING** has braking effect of dynamic braking, but power is returned to the line instead of being lost. Induction and dc motors if driven above rated speed by overhauling load act as generators. For non-overhauling loads, scheme above is sometimes used. Two-speed motor runs with high speed connection. When braking, winding is reconnected for one-half running speed.

Up-to-date PRACTICAL IDEAS *to lick some of your*



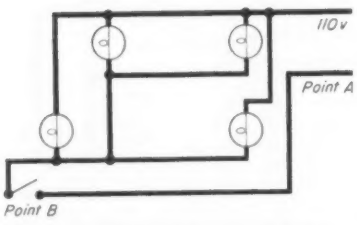
Grumbling feedwater tank? Not with this heat exchanger

We had two problems: (1) excessive hammering in our low-pressure boiler-water makeup tank (2) high feedwater temperatures. These conditions were caused by the irregular return of large quantities of flash steam. Problems were solved by installing a small heat exchanger, photo, above.

Boiler-feed pump would steam-bind —result was low water in the boiler. Then high pressures built up in the return system, lowering heating efficiency in the entire plant. Another headache was flash steam returning from a group of processing cookers where operations were being pushed to speed up our rate of production.

Now tubes of our new exchanger are connected in series with the troublesome steam return pipe before it discharges into the feedwater tank. Other side of exchanger is connected in series with cold makeup water. Immediate benefits: (1) no noise in makeup tank (2) saving of steam previously lost because of excessive pressure requiring venting to atmosphere (3) lowering the feedwater temperature to a controllable average of 180 F (4) reduction of pressures in return lines to normal levels. Cost of exchanger was only $80.00.

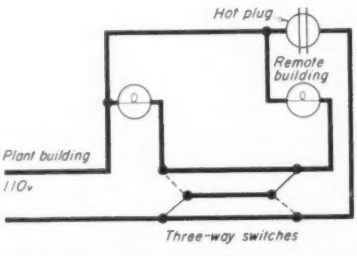
H NYE JOSLEYN, *Fort Dodge, Iowa*



No need for extra switch

We had to change entry to a large, high room from point *A* to point *B*, sketch. Feeder for the lights came from *A*, but no one wanted to climb those high trusses and pull in another switch leg. Sketch, above, shows how we solved this knotty problem.

T E MOYER, *Longview, Wash.*



Hot plug for heater

On an old wiring installation to a remote pump house, we provided a hot plug for a heater without interfering with "off-on" operation of floodlights outside the pump house, sketch. And we didn't interfere with the plant that was controlled by the 3-way switches.

T E MOYER, *Longview, Wash.*

Air compressor trouble shooting

Foreman on a steel erection job had a real worry: His air compressor wouldn't work and, as a result, his men couldn't drive rivets. Unit was a small vertical machine with compressor cylinder mounted on top of gasoline engine cylinder driving it. Both compressor piston head and gasoline-engine piston head were mounted on a common piston rod.

When working normally, machine would pump up storage tank to 110 psi, then cut in and out as demand required. Now, it would start, pump up to 70 psi, then stall. Foreman was worried he'd lose his job if he couldn't fix it—and mighty quickly.

He asked me for help. I checked the unit. Gas engine seemed to be OK —delivered full power, yet stalled when compressor delivered only low air pressure. I diagnosed trouble as a leaking compressor delivery valve and told the foreman to get his mechanic busy grinding it in. This was done quickly, and soon the riveters had all the air they needed. But foreman couldn't understand how I knew just where the trouble had been.

I knew the gas engine could carry only a very small percentage of overload. Its piston could suck in only so much explosive mixture. So it stalled when loaded beyond its usual limit. Compressor cylinder could suck in just so much air each time and it reached full terminal pressure during last small percentage of its stroke.

But if delivery valve leaks badly, air cylinder fills with air from storage tank instead of outside atmosphere. Then full terminal pressure is reached much earlier in compression stroke. So driving unit had more work and caused gas engine to stall at low air-storage pressure.

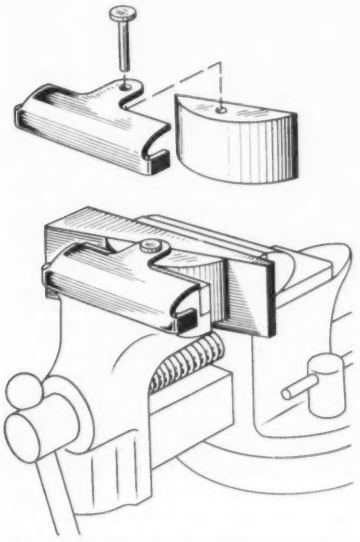
Severe leakage can cause alarming distress in a belted compressor.

On another job, one leaf of a multiple leaf discharge valve failed completely. When attendant checked machine, he found electric motor hot from overload, belt threshing and flopping; and delivery pipe bright red for ten feet from the compressor. Strip valve failure had been severe enough to have piston force a full cylinder of air at terminal pressure out during the full stroke. Then it instantly got same air

back through the leaking discharge valve. This poured more heat into the air, until steel piping had turned red.

An explosive gas could have formed and been ignited by the hot pipe. It must have been the engineer's lucky day. So watch those air leaks.

H B McDERMID, *Long Beach, Calif.*



You can hold taper work

When you have taper work to hold in the bench vise, try making this simple 2-piece swivel attachment, sketch. Saw a half-round section from a casting or round bar. Drill a hole and make a holder of sheet steel or heavy brass. Shape to vise jaw, assemble with a pin and you have your attachment.

C H WILLEY, *Penacook, N. H.*

Grease for wrinkle paint

Many instruments are finished with wrinkle paint. Although they're attractive when new, main trouble is that dust and dirt gets into the rough surface. After a short time they look pretty bad. Washing with soap and water doesn't seem to do much good. But I found an easy way to bring back their original sparkle. Smear a little vaseline on the surface, then brush it in well with a small hand brush. Wipe it off with a cloth and you have a new looking instrument. It works very well.

W R SCHNARRENBERGER, *Pittsburgh, Pa.*

What would you have done?

Everybody was extending himself to get the most tonnage possible out of the mine before the lease expired. As a result, the little old motor-generator set was hot enough to fry eggs on; and the trolley wire was too warm to touch.

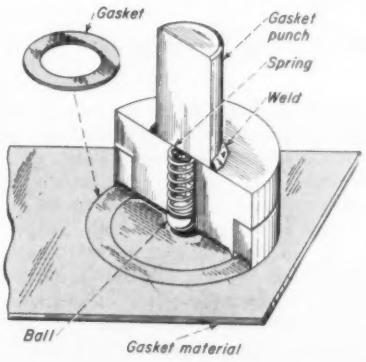
As might be expected, the circuit breakers were set up to maximum to keep all equipment running as near to capacity as possible. But as is usually the case, something besides the circuit breakers began to show signs of heavy overloading. The 600-amp knife switch in No. 3 circuit was showing considerable distress; its once-bright copper was turning a gun-metal blue. Even the oil-impregnated slate panel it was mounted on showed a dry, gray spot around each bolt. You could light a match on the slate at that point.

In the rear of the board, solder running out of the feeder cable formed stalagmites. With only one side of the switch in service, it was high time we utilized the reserve capacity. This was done by shunting horizontally across the top and bottom mounting bolts with sections of a comparable size bus bar.

We waited until shift change before unbolting the bum lug. We turned both the lug and the cable over 90 deg and finished running out all the solder. Then, with the higher heat available from an oxyacetylene torch, we silver soldered the lug to withstand the higher operating temperatures. What would *you* have done?

P C ZIEMKE, *Clinton, Tenn.*

Small gasket punch saves time



We had to cut several hundred small gaskets from hard sheet packing in a hurry. Problem was solved with gasket punch shown in sketch, left.

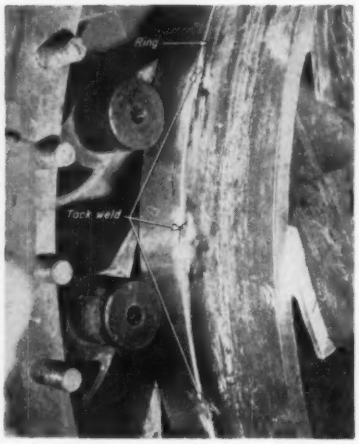
Body and inner cutting edge was turned from mild steel. Center hole was drilled for ball bearing and spring. Ball exerts enough pressure on blank part of gasket material to eject it when punched. Outer ring of punch slips easily on and off punch body to permit cut gasket to be lifted.

Both cutting edges were hardened before inserting ball and spring. Then the striking post was welded onto body. For small gaskets this punch is a honey.

L S FRAHS, *San Francisco, Calif.*

More PRACTICAL IDEAS

Begins on page 128



Here's your trick of the month

When a seal ring on a hydroelectric turbine becomes eroded or pitted, runner is usually removed from scroll case, taken off shaft and shipped to a shop with a large boring mill for machining.

But we installed a new seal ring on the 20,000-hp runner of a twin horizontal turbine without removing the runner from position. Only the draft chest covers had to be removed. Here's how we did it:

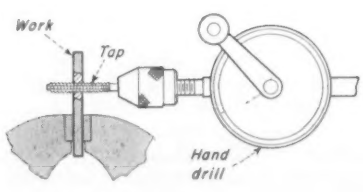
Our problem was to turn the shaft with its runners at low speed so machining could be done. To do this we attached a sprocket wheel to one end of the shaft. Then, with a 90:1 speed reducer from another piece of equipment, the shaft was turned at 2½ rpm. This speed was ideal. With the steady-rest installed, as shown in photo, faulty ring was machined to right diameter.

Next, a 21-ft length of 1x8-in. stainless steel was rolled, giving a ring of about 1 ft diameter. This was welded, reinforced with spokes and sent to an outside shop for machining on the inside. Then it was machined to 6-in. width. Reason for the original 8-in. width was to take care of the spokes, also to facilitate machining.

Before slipping the ring into place on the runner, we had to cut it in halves so it passed over the shaft. Ring was clamped into place and tack welded, second photo. Next, it was welded all around the circumference. With the driving mechanism, all welding was done in the ideal "down" position as the runner was inched around. After welding, the new ring was machined on the outside diameter.

L McWILLIAMS, *Shawinigan Falls, Que.*

You can tap sheet stock with hand drill



Next time you have to tap a lot of holes in nonferrous metals such as brass and aluminum, use a small hand drill, sketch. You can tap holes rapidly by this method. Just grip the tap in the chuck of a small hand drill. To prevent tap from slipping in drill chuck, you can grind three longitudinal flats on the shank for the chuck's three jaws. I've used a carpenter's brace for tapping larger holes. Sure comes in handy.

C T BOWER, *London, Eng.*

Boiler safety hints . . .

(1) Use only safety type electric cord in a boiler. Never handle metal parts of terminal end while in boiler. If you must use electric drill, ground the frame unless it has a ground wire. Use low voltage of 6-volts only

(2) Make sure blowoff valve is closed; and that both main stops are closed and drain is open. If drain is piped to a blow tank, leave drain closed. Make sure feed stop is closed. If close to feed stop of live boiler, lock it shut. Keep key in your pocket.

(3) Make sure that safety valve discharges and other vents cannot feed back into dead boiler. Make sure soot blower won't be opened while working in fireside passages. Disregarding these conditions kills or injures many inspectors, engineers and maintenance men every year.

(4) You may have to work inside boilers in freezing weather (brickyards and cement mills when winter is dead season). You can't get into some boiler parts with bulky winter clothes. Often all that's between you and cold metal and air is a couple of thicknesses of cotton overalls. At times, salamanders are set up and vented into boiler setting. You can get a heavy charge of carbon monoxide unless you watch conditions. Know your plant. You'll be more comfortable while working in the boilers and you'll live a lot longer.

F G GILMOR, *Albany, N. Y.*

Do you readers know this?

In our ammonia refrigeration plant I have to check the liquid level in the receivers. But there are times the level cannot be seen. I solved the problem by holding a pencil behind the glass at a slight angle. If there's liquid in the glass, portion of pencil behind the glass is distorted, shows up at right angle to the pencil. And if glass is empty, you can see the pencil without distortion.

P H KING, *Melbourne, Australia*

EDITOR'S NOTE: Some plants place a panel of black and white stripes, running at 45 deg to gage glasses, in back of glasses. A permanent fixture of this kind always shows you where the liquid level is, whether in boilers, receivers, or what have you.

Turn page for more Practical Ideas ►

Turbines Get Acid Stomach, Too!

But Cities Service Has The Cure

As they steam through the day, turbines, like people, develop dangerous acid in their systems.

Unless controlled by a properly, highly fortified lubricant such as Cities Service Pacemaker-T Oil, this acid will contribute to sludge formation and attack the metallic surfaces inside the turbine.

Guarding against acid and sludge is just one of many important protective jobs done daily by Cities Service Pacemaker-T Oil. In addition, this superior lubricant provides unsurpassed anti-foam and anti-rust protection plus maximum oxidation stability and water separation.

There's a Cities Service turbine oil for every kind of turbine, every type of oiling system. Ask your Cities Service Lubrication Engineer for details. Or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

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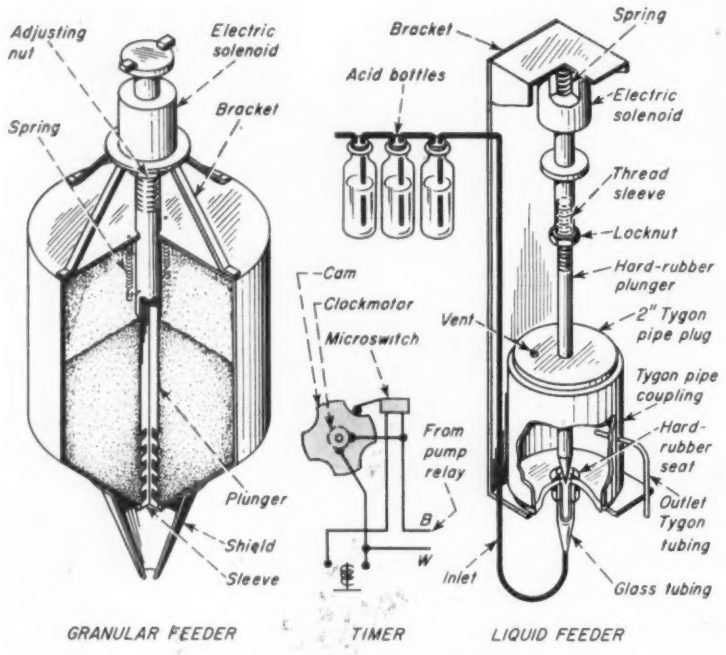
More PRACTICAL IDEAS

Begins on page 128



Two ways to feed acid to cooling towers

We use two methods for feeding acid to our cooling towers to adjust pH. One is a granular feeder, the other a liquid feeder.

After experimenting with ways of feeding acid to our towers, such as little slugs, dripping and various other methods, we settled on these two. Granular feeder uses sodium bi-sulfate. We installed it on a small tower inside of plant building.

As first sketch shows, it's a sheet metal hopper with a plunger actuated by a solenoid. Bottom end of plunger has grooves machined so when plunger is activated, granules collecting in grooves will be discharged into shield and out bottom. When plunger returns, granules refill in grooves, discharge when plunger is activated again.

Solenoid is energized by a relay from the hotwell pump, second sketch. While pump is running, the circuit is energized. As clock motor turns cam, the microswitch, riding on cam, makes and breaks the circuit to the solenoid. We have found makeup and evaporation rates are closely proportionate to the time hotwell pump runs. We had intended to hook it to raw-water meter with a vernier timer, but have had very good results as it's now wired.

Results were so good with this feeder that we made another one for a cooling tower outside of building. We ran into a snag there on account of the bi-sulfate having an affinity for moisture. So we installed small light bulbs and heaters to keep bi-sulfate dry, but they were not very satisfactory.

Then we experimented with a liquid feeder, using diluted acid. As second sketch shows, we took a Tygon pipe coupling, inserted a hard-rubber seat inside bottom of Tygon pipe plug, and screwed both together using solvent for a tight joint. Short length of ¼-in. Tygon pipe was cemented to bottom side of pipe plug. A piece of ¼-in. glass tubing was then cemented into the Tygon pipe.

Where glass tubing is cemented, it was first roughed up with sandpaper to etch the surface. Then we dipped it into Tygon solvent, inserted into Tygon pipe with a twisting motion. It gave us leakproof joints. For the top, we took another pipe plug, drilled a vent and hole for the plunger. This hole acts as a plunger guide.

Solenoid plunger was drilled and tapped to receive threaded sleeve. Sleeve is drilled and tapped on bottom end to receive threaded end of plunger. Stroke is adjusted by turning plunger in or out of threaded sleeve. Bottom end of plunger is turned to a long needle-nose point.

We use three 1-gallon bottles for the acid. They are raised about 2 ft above the feeder, with siphoning tubes in them.

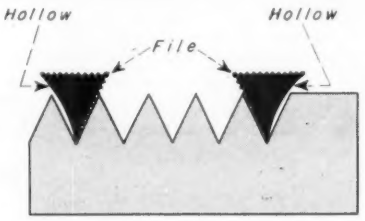
Equipment used for energizing solenoid is also used for dry feeder. Each time solenoid is energized, plunger is raised and acid is siphoned out of bottles through feeder inlet. Level in feeder is maintained by level of outlet tubing. Excess flows out through outlet tubing.

These feeders have been in use for almost two years and have been practically maintenance-free. They give us good control over Ph for cooling water.

F E Ziegelmann, *Fullerton, Calif.*

Moisture damage

Do you know how to prevent electric motors from being damaged by moisture? And if your motors are damaged, do you know how to dry them out? *Plant Operators' Manual* shows you with detailed sketches. Order your copy now. McGraw-Hill Book Co.



File for dressing threads

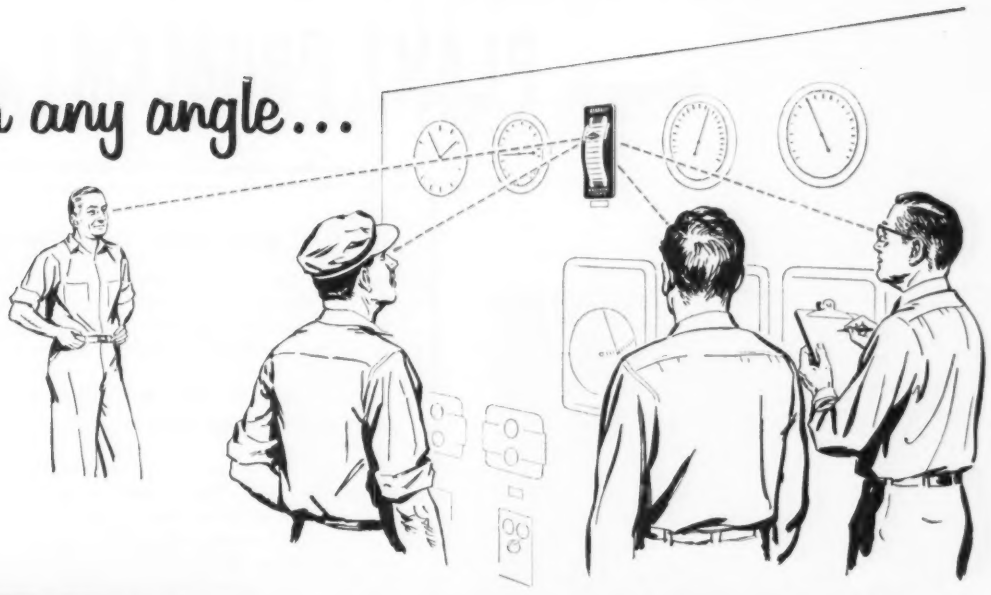
Do you ever have to clean up V threads on a large screw or bolt? Best way is to hollow-grind a three-cornered file, sketch. (Corners on regular file are too round.) By hollow grinding one side of a file you get one sharp corner; by turning file, both sides of a thread can be cleaned up. This file is a handy item to have in your maintenance shop.

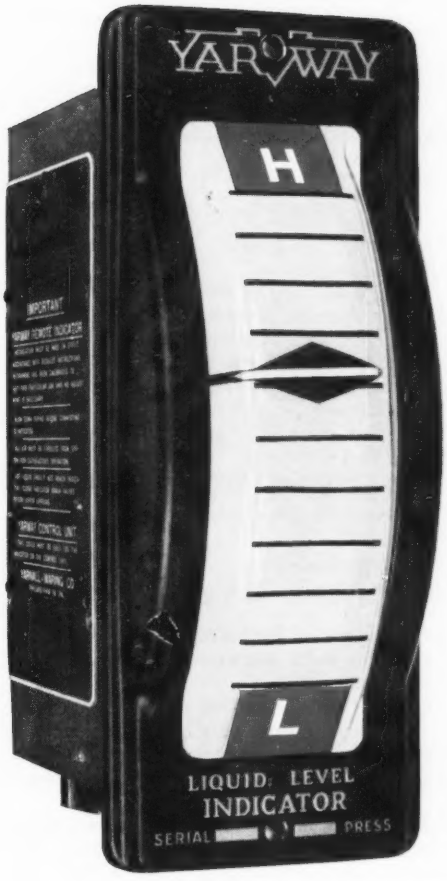
C W Milmon, *Houston, Texas*

My biggest boner

Please turn to page 226

from any angle...





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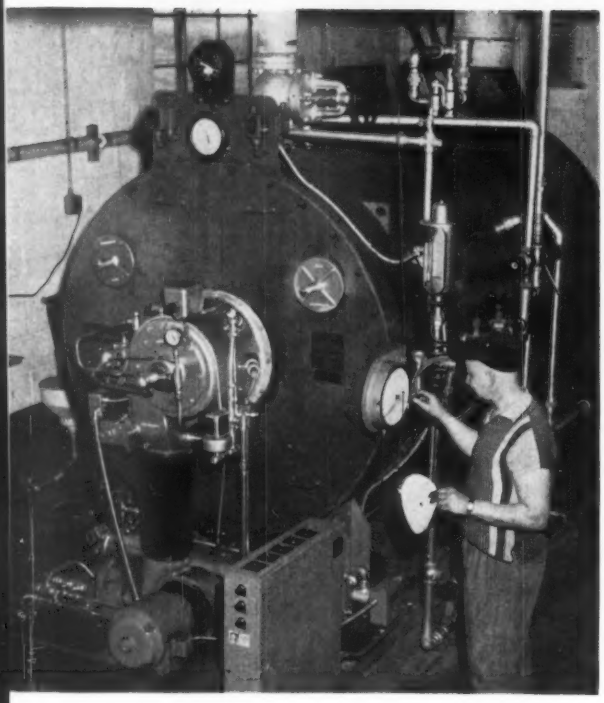
Have a PLANT PROBLEM? Tap the



The problem

Why do stack temperatures get so high?

We have two 80-hp boilers. They are packaged type, automatically gas fired. Pressure control allows either 95- or 45-psi generation.

With both boilers operating together, or each one operating separately, combustion efficiency is 82½% (by CO_2 indicator). Stack temperature of one ranges between 450 and 700 F, depending on firing conditions. Temperature for second unit at the same point, and under seemingly identical conditions, ranges between 600 and 900 F. Can *Power* readers tell me how to correct this condition?—*GAR, July Power*

The solutions

Are boiler tubes dirty?

Assuming that *GAR's* boilers are conventional firetube design, difference in stack temperatures between the two units probably results from dirty tubes or broken baffling that allows hot combustion gases to short circuit one or more passes.

When tubes are dirty their areas are reduced, cutting down on the heating effect of combustion gases. Dirt acts as an insulator.

If *GAR* is burning No. 5 fuel oil, this may be the source of trouble. If it is not a genuine No. 5, if it is artificially produced by blending No. 6 and No. 2, it might stratify. This is what happens when blending isn't done thoroughly.

In general, a good rule to remember is that stack temperatures should be about 100 F above steam temperatures.

T M Small, *Providence, R. I.*

Efficiency not the whole answer

On boilers of this type, efficiency is not the whole answer—any efficiency over 80% is good. But it doesn't pay to try for increased efficiency that will result in increased maintenance. *GAR* should try to maintain both boilers between 375- and 500-F stack temperature.

To reduce stack temperature he should try the following: (1) Clean heating surfaces, fireside and waterside. (2) Change firing rate to recommended value. Check with manufacturer on fireside heating surface. On low or partial loads high stack temperature can be expected. (3) Check boiler draft loss. If too high, a restriction may be present that would cause poor combustion and soot on tubes. (4) Make sure overfire draft is correct.

D Rinder, *Fitzgibbons Boiler Co, New York, N. Y.*

GAR's problem is excess air

The problem is a result of excess air to the furnace. It lowers the temperature there and causes much of the heat to go out the stack.

It is an axiom of boiler operation that a hot furnace produces a low exit temperature. In a hot furnace most of the fuel energy is transmitted by radiation to the heating surface which can be "seen" by the flame or incandescent refractory.

As the boilers are automatically controlled, there may be parts of the on-off cycle when the burner produces a rich flame which deposits soot on the heating surface. With gas fuel, a throttled air supply will result in a richer, wasteful and sooty mixture. With solid fuel it results only in a slower rate of combustion. Be sure that air supply to the boiler space is not throttled by closed doors or windows. A draft gage connected to the outside would prove it.

J A Graham, *Pittsburgh, Pa.*

know-how of over 45,000 Power readers

HOWARD KALLEN, *Associate Editor*

Consider these four possibilities

CO_2 indicator is in error if indicated stack temperature is correct. Combustion efficiency of 82.5% is not possible with this stack temperature. The following table shows approximate stack loss and combustion efficiency (100 – stack loss) for natural gas firing with 15% excess air:

Stack temperature	Stack loss	Combustion efficiency
450 F	19%	81%
600	23	77
700	27	73
900	30	69

Infiltration may be taking place (possibly away from the point of CO_2 sampling), diluting the combustion products, increasing gas velocity, decreasing heat-transfer rate and increasing stack temperature.

Boilers may be operating considerably above design capacity. This may occur for short periods when steam pressure is low and burners are firing at maximum rate. If load is fairly steady and modulating burner control is used, *GAR* may be able to operate with lower maximum firing rate. Burners will stay in the high-fire position longer but stack temperature will be lower.

Air-fuel ratio could be too high. Check for excessive furnace draft, poor control of forced draft or combustion air.

F A FELLNER, *McHenry, Ill.*

These tests should be run

GAR states that both boilers have equal combustion efficiency. That doesn't mean they are using equal amounts of fuel or are producing equal amounts of steam.

He should check to see that both boilers are equally free of soot and scale, that baffles aren't broken and that there are no air leaks. Also, amount of fuel burned by each boiler should be determined at equal combustion efficiency.

If boilers are connected to a single stack, draft should be checked at the boiler outlets to see that they are equal.

Results of these checks should show up the cause of *GAR's* high stack temperature.

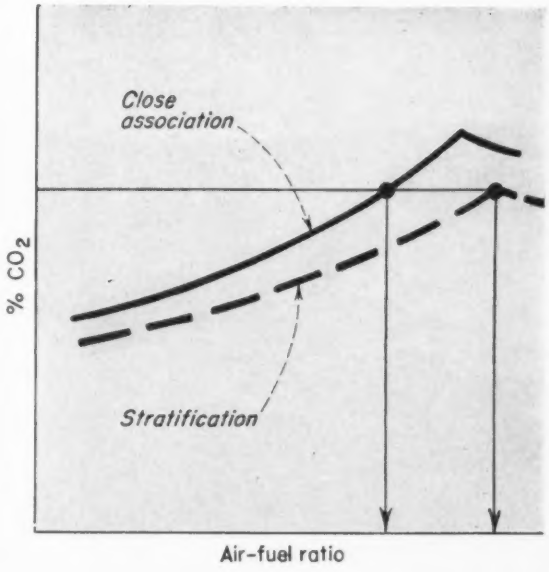
I A BUTCHER, *Cincinnati, Ohio*

Have retarders been replaced after cleaning

Assuming equal draft and equal loads, the trouble could be that one of the boilers uses retarders or twisters in the tubes while someone has removed them from the boiler with the higher flue-gas temperature.

A friend of mine operating a packaged firetube boiler had a similar experience with high gas temperature. After cleaning the boiler, the crew neglected to replace the retarders. Result: Exit gas temperature went up 150 F.

A F SHEEHAN, *Springfield, Mass.*



GAR should check all symptoms

An operating engineer should use the stack pyrometer as a physician does an oral thermometer. Just as high body temperature indicates sickness, high stack temperature may indicate a dirty boiler, faulty burner or even failing brickwork.

The weakness of testing flue gas for CO_2 only is that a burner which doesn't thoroughly mix fuel and air can produce stratification in the firebox. Result: Any given % of CO_2 would indicate a smaller amount of air for combustion than might be expected, graph above. Orsat readings will pinpoint this condition. *GAR* can correct it by adjusting the burner until CO_2, O_2, and CO readings correspond. For natural gas the following can be used as a guide: 9.6 to 10.0% CO_2, 4.0 to 4.4% O_2, zero to 0.2% CO.

Usually an increase in primary air is the solution. If *GAR* has poor combustion. he may find that the fireside of his boiler has sooted up, retarding heat transfer and increasing his stack temperature still further.

Frequently small boilers such as these are operated without proper feedwater treatment. So *GAR* would be wise to check the waterside too.

If the boiler has any type of preheat for the air, a leak in the brickwork could cool the firebox and downcomers so a given steam load would require more heat. If combustion is being controlled according to CO_2 readings, incomplete combustion is probably causing even more waste.

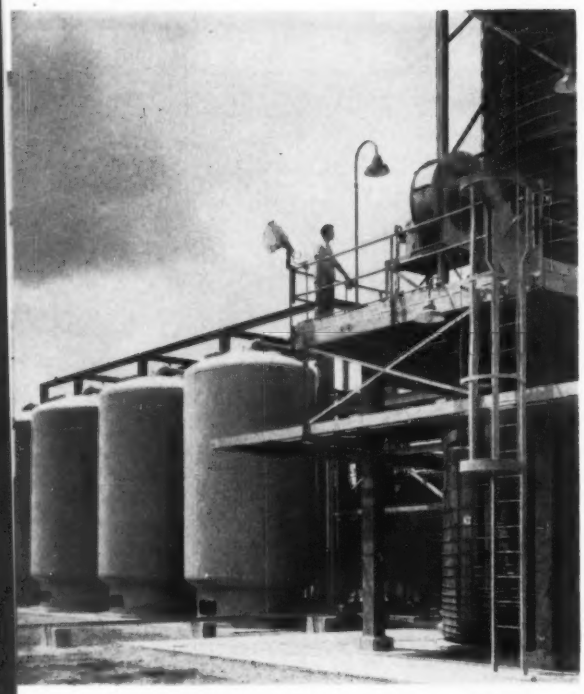
H HOLCOMBE, *Los Alamos, N. M.*

Want help with your plant problems? Send your design and operating headaches to us. We'll put Power readers to work on them

For more on ion exchange resins, new problems, turn page ►

More PLANT PROBLEMS

Begins on page 134



The problem

How can we keep anion exchange resins from deteriorating?

We have a two-bed demineralizing system in our power plant that passes 100 gpm continuously. Effluent is normally expected to contain about 3-ppm total dissolved solids. We use a surface-water supply that goes through a coagulator and filter before entering the demineralizer.

The plant was originally designed for daily regeneration. It's now necessary to regenerate the anion unit twice a day. Unless we can stop this capacity dropoff, we'll have to replace the anion resins. The incoming water has been regularly analyzed and there has been no significant change. Have *Power* readers had similar experiences? What can we do to lick this knotty problem?—*MR, July Power*

The solutions

Trouble may be organic matter, silica

Most probable source of trouble resulting in capacity loss of ion exchangers, especially of the strong-base type, is organic matter and undissolved silica. In the case of a surface-water supply, organic matter is a common problem.

Often, a cleanup operation can be done on an anion exchanger which has been subject to organic fouling. Such a procedure would consist of rinsing the resin with a warm brine solution. A 5 to 10% solution at 100 F is very effective. But be sure to check manufacturer's figures for stability of the particular anion exchanger, before treatment. Some anion exchangers are adversely affected by elevated temperatures. The effluent will probably show some degree of coloration. Disappearance of such color is a rough indication that cleanup is complete.

If the brine treatment doesn't prove effective, it may be necessary to resort to a more drastic treatment. This would consist of a 0.25 to 0.50% solution of sodium hypochlorite, adjusted to a pH of 11 by means of sodium hydroxide. Solution is added at room temperature and allowed to remain in contact with the bed for several hours. Agitation of the bed is desirable.

Hypochlorite treatment should be followed by a second brine treatment. Then, after a double regeneration (regeneration-backwash-regeneration-rinse), the bed should be ready for use.

If the difficulty is caused by silica fouling, regeneration with warm caustic is often effective. But, if fouling has progressed too far, even a drastic cleanup procedure may not help. Resin may have to be discarded.

Improving pretreatment procedures may also help solve the problem. Even if the resin isn't replaced, filtration over activated charcoal should be considered since the organic and undissolved silica content of the present influent water is apparently quite high.

G P Herz, *Levittown, Pa.*

Follow this careful procedure

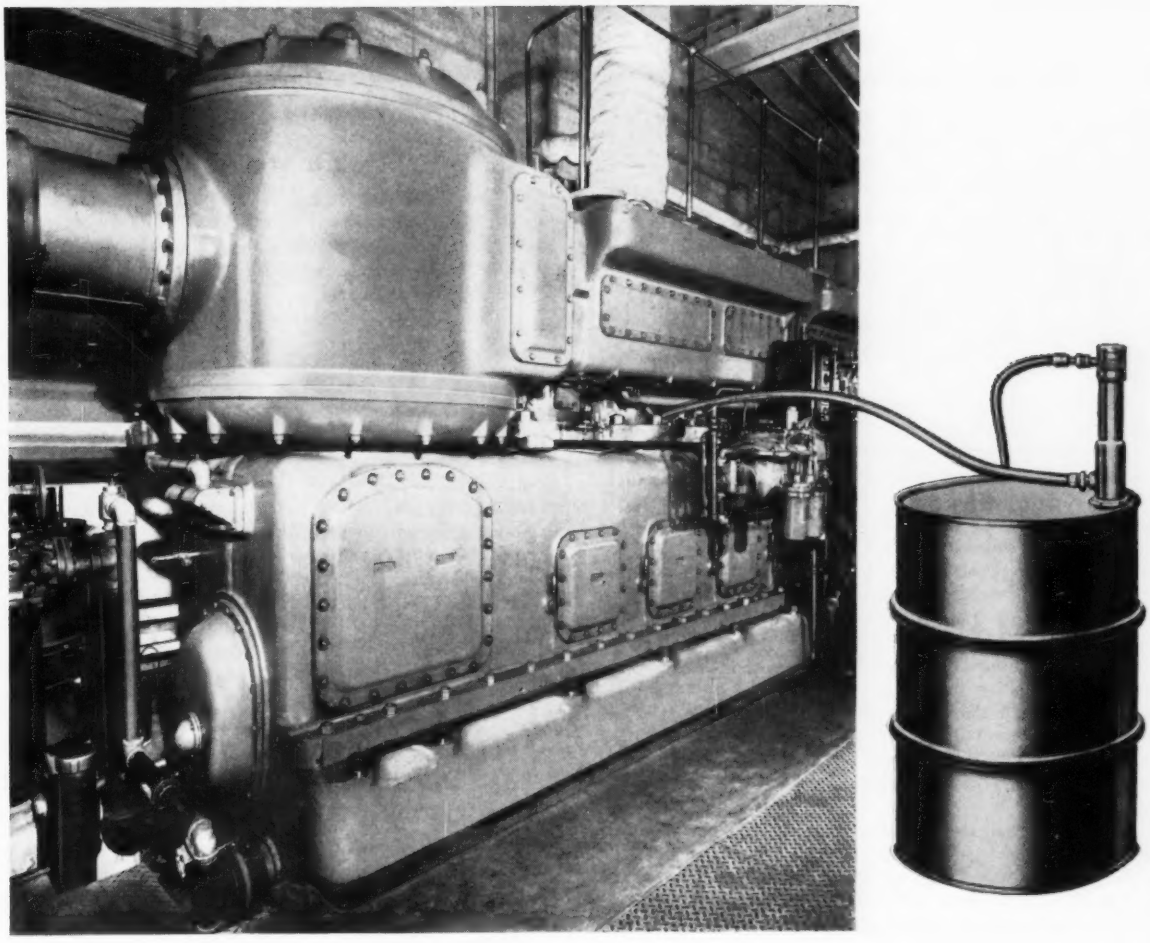
Dismantle the manifold and determine the condition of the inside. Generally you will find erosion at one or more of the ports. Resulting leakage past the gasket may cause a short circuiting of flow or weakening of vacuum, causing dilution of your acid or caustic charge. Check the manifold and replace with new parts where necessary. And be sure all pipe joints are tight, especially the suction line to the acid or caustic.

If your trouble is not in the manifold, take the cover off the unit to determine how much resin is missing and whether or not it is clean. If the level is substantially lowered, the backwash rate has been too high. If the resin is dirty it has not been backwashed properly. Clean resin should not be thrown out—it does not deteriorate. Add new resin to it after removing dirty resin from the unit. Transfer dirty resin to 50-gal drums but don't fill them. Fill the drums with water, agitate the resin and pump the dirty water off the tops of the drums. Repeat until resin is clean. Then pump it back into the unit.

C S Carr, *Churchville, N. Y.*

For more on ion exchange resins, new problems, turn page ►

Varnish Problem Vanishes!



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More PLANT PROBLEMS Begins on page 134

We had a similar experience

We ran into similar trouble when filters became clogged with mud and slime. We use surface water from a canal directly watered from the St. Lawrence River. Turbidity or muddiness of surface waters during spring run off and heavy rain periods, soon builds up considerable mud and slime on top of sand beds in filters. Muddy and contaminated water enters softeners and, in time, coats resin beds, reducing their water-softening power.

Once a year, after the spring season, we open filters, clean as much mud and slime out mechanically as possible, and condition filters with a 10% sulfuric acid and water solution.

Another difficulty that caused a dip in softening effect was overloading the softeners. We started out with two filters and two softeners, but during backwashing and regeneration of one softener, the other was overloaded. This caused a considerable pressure differential between inlet and outlet. We had to use city water to offset the differential across the softener bed and to supply enough water to maintain water level in the deaerating heater. Also, we had to eliminate upheaval and loss of zeolite in the softener bed. Our solution was to install an additional softener and filter.

We believe a plant must have extra-water-treating capacity to cope with low initial pressure of surface-water supply and to carry load while other softeners and filters are being cleaned, conditioned and regenerated.

Water meters on softeners should be cleaned of sand. We had to send ours back to the factory for calibration and parts check.

We use the soap test on softener water effluent. If water shows a trace of hardness, regeneration must be performed more often. Backwashing on filters should be done when gages show a 5 to 10 psi differential. We try to keep density of brine for softener regeneration above 20 Baume; our usual readings run about 23 to 24 Baume.

MR should check depth and condition of resin beds in softeners. After adding resins, allow for swell. The brine distributor should be about six inches above bed for best operation.

We backwash filters and regenerate softeners two to three times more often when surface waters become very turbid or muddy. Important: Vent all air before starting wash. And don't wash a filter and softener at the same time.

A BELTON, *Montreal, Canada*

Is Mn or Fe being removed from water

It is possible that manganese or iron is being filtered out of the water and is forming a bond to which the organic matter adheres. I suggest that 5 to 6 ppm sodium hexametaphosphate be fed into the water, directly ahead of the softeners. Capacity should be restored within 48 hours.

There is one disadvantage to this method: If there are closed high-pressure feedwater heaters, their temperature must be watched closely because under certain conditions it's possible to deposit scale on the tubes.

E HILL, *Norfolk, Va.*

Your November problems

Can we install a water meter in our boiler-feed line?

I'd like to know whether it is practical to install a water meter in our boiler-feed line under the following conditions:

The feed pump is a horizontal reciprocating duplex. Suction is 5 in. diameter and is connected to a deaerating heater. Head pressure on suction side is 20 ft, plus 5 psig in the deaerator. Discharge line is 2 in. diameter, 100 to 130 psig, water temperature is 230 F. Normal flow rate is 20 gpm but it can vary from 3 to 50 gpm. And under free flow it is possible, during short periods of blowdown, for flow rate to reach 100 gpm.

It's also possible, under abnormal conditions, for this pump to run dry or become steam bound and cause a heavy water hammer. The pump feeds three 100-psig water-tube boilers, each of 1500-sq ft heating surface.

I've never heard of water meters being used under such conditions and would like to know if it is a practical methods of measuring water use.—*HCG*

What's the best material to use for steam coils?

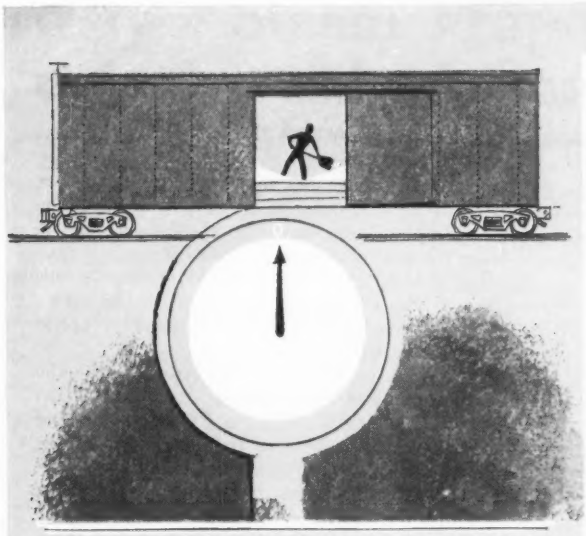
We are replacing steam coils for a customer who has had poor service from coils made of plain steel tubing.

Steam conditions are 600 psig, 600 F. Service is intermittent; on a few hours, then cold. We doubt if they really drain the system dry.

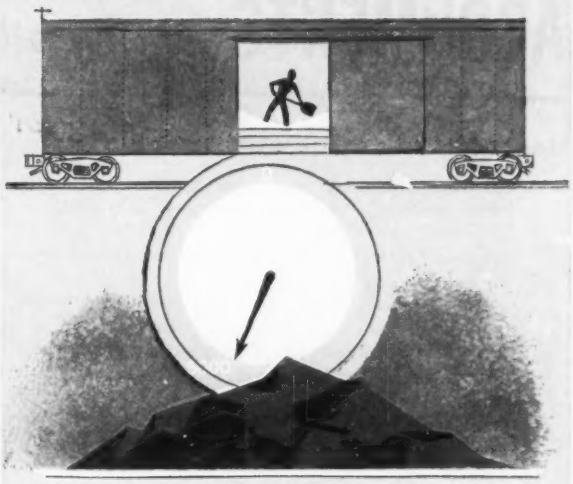
On the high side of the valves, fittings and pipe are, of course, steel. But on the low, wet side, parts are bronze or brass. This leads us to suspect the possibility of galvanic action. The outside surface of the coil is subject to oxidation, but only moderately.

We're considering making the new coils out of monel since it would probably have the best resistance to galvanic corrosion and has good properties in other respects. But how would it stand up under the temperature and pressure? And how thin a wall do you think we could get by with? Diameter is ¾ in.; coil about 200 linear ft. Not a big job, but one we'd like to do right.—*GR*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches.



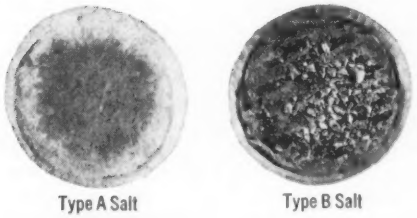
A carload (50 Tons)—of Morton Purex Salt contains virtually no wasteful insoluble matter or sludge—shale and sulphates.



A carload (50 Tons)—of salt can often contain as much as 5000 lbs. of sludge which you pay as part of purchase *and* freight costs.

Stop paying for wasteful sludge —switch to Purex Salt

These filter pads (approximately 1/5 actual size) show you how much insoluble matter (sludge) you get in just 5 lbs. of various kinds of salt.



Type A Salt

Type B Salt

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ARGUMENTS . . . *let other readers know your views*

ALTHEA THORNTON, *Assistant Editor*

Upcoming transgenerator: Too big?

Re your September issue: It's terrific, particularly "The power field today and tomorrow." I'm digesting it in small bites and my guess is that the bulk of your readers will do the same. One doesn't just skim through a magazine like this.

However, with one mouthful, I bit down on something hard, namely the proposed "transgenerator."

It's my impression that power-plant designers strive for compact and efficient physical distribution of components. And equipment designers figure ways and means to produce units that'll do more work, yet won't occupy more floor space.

More efficient cooling systems and shorter generator leads would be nice features, but what about the *size* of this transgenerator? It mightn't matter for outdoor plants, but for conventional generating stations (which'll be in the majority for a long time to come), isn't it likely that a combination generator and transformer (s) be a mite too ponderous?

G A Foster, *Bremerton, Wash.*

Might seem so, but . . .

Reader Foster's point is well taken regarding putting the transgenerator in a conventional building. Another deterrent to such a location is the traditional concern for transformer fires. The transgenerator is part of a completely unconventional scheme of electric power generation, transmission and distribution which power engineers are gradually developing to meet the tremendous needs for electrical energy in the world of tomorrow. Nuclear reactors as heat generators, semi-outdoor steam-turbine generating stations, dc transmission at voltages above 500 kv are all part of the picture.

Most of it is in the experimental or speculating stage, but the trend is under way. Internal liquid cooling of generators is a fact, and is turning in an encouraging performance. Direct-current h-v transmission is being field tested in large projects in Europe. The transgenerator, though still in the speculating stage, is not too radical a departure, considering its advantages with a unified cooling system, lower generating voltage and smaller overall bulk.

Economics as well as engineering will determine how soon it is developed. As you rightly predict, more conventional generating stations will be in the majority for some years yet.—Norman Peach, *Asst Ed*

Who'll provide the training?

I'd bet money that every Power subscriber is enjoying your September issue as much as I am, but I hope they're not experiencing my feeling of misgiving that's prompted by "The power field today and tomorrow."

This section's theme, from beginning to end, is that tomorrow's power plant equipment will be even more complex than today's. For example, automatic refrigeration system controls and boiler feed, feedwater treatment and combustion control systems today require considerable study by operating personnel in order to understand what goes on. Yet your September issue tells us that "control engineers promise even more (complex automation) for the future."

I don't doubt for a minute that what you tell your readers is true, but it's a little frightening to me, because Power stresses the importance of tomorrow's plant people having the know-how to supervise operation of these complex systems.

My question is: How does tomorrow's guy, who didn't go to college or a crack vocational school, get this know-how? A man can go, as I did, to any one of a number of day or evening training schools. Here, for a reasonable fee, he can study and tinker with diesel engines, air compressors, refrigeration systems, or whatever the school's specialty happens to be. (Incidentally, I never heard of a school devoted to training *boiler operators*, did you?)

Big drawback in practically all of these schools is the age of the machines used for study. Two schools I attended had equipment that wasn't as modern as the machinery I worked with every day. It isn't the schools' fault, because few could afford the investment to provide the latest equipment at all times.

It's fine to "learn by doing," but what's the gain if you "learn" on some school's obsolete plant, then step into a job involving a bewildering array of complex systems such as prophesied by Power?

This is a serious problem and I'd think equipment manufacturers and industrial management would be worried too. Both have a big stake in the future and realize how big the need for trained men will be. But how will these men get this up-to-the-minute training?

F L Sanders, *Toledo, Ohio*

Ed. Note: Anyone have a suggestion?

Plant should standardize bearings

In July *Arguments*, C A Gill lists his recommendations for correct lubrication. There isn't any room for an argument here; anyone following his suggestions should be able to cut lube problems to a minimum.

But, I'd like to add another tip—concerning the equipment to be lubricated. When specifying new equipment, it'll simplify the lubrication program tremendously if the purchaser standardizes on bearings and components that need oiling or greasing.

Standardizing bearing type, design, method of lubrication and location of lubricant feed is a big factor in establishing and maintaining a satisfactory program at minimum cost. Some major benefits are: reduced lubricant inventory, less tools and other accessories. Further, men responsible for carrying out the program quickly become familiar with the routine because they're dealing with fewer types of equipment.

Last but not least, discussing lubrication methods and problems with the equipment operators and maintenance people before drawing up the specs helps to avoid need for corrective measures after installation.

H B Wayne, *Woodhaven, N. Y.*

We'll pay beer money for your pro or con views on worthwhile controversy. Write to Bob Bellas, Asst Ed

Why a Steam Trap Has to Handle "Air"

Low temperatures and corrosion of equipment are often evidence of inadequate trap air venting capacity

Air, with its load of oxygen and carbon dioxide, has an unwholesome habit of interfering with the efficiency of steam heated units. If steam were always free of these undesirable companions, things would be a lot simpler for men-who-operate-plants. Because it isn't, three unhappy situations frequently occur:

1. ***Operating temperatures are subnormal.*** This is a two-part problem. First, an air-steam mixture has a lower temperature than pure steam at the same pressure—see Table A. Secondly, air can "plate out" on heat transfer surfaces as shown in Figure 1. Under some conditions, such an air film will knock down heat transfer efficiency by as much as 50%.

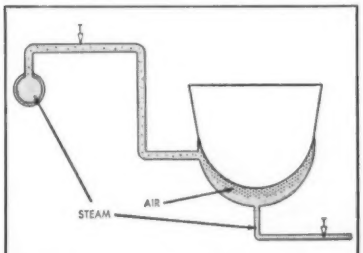


Fig. 1. *How air can "plate out" on heat transfer surfaces. This "insulation" drastically reduces heat transfer efficiency. Armstrong trap operation creates turbulence in the equipment that prevents this.*

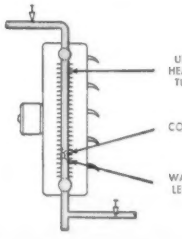


Fig. 2. *Corrosion occurs when units are not kept continuously free of both condensate and air. Armstrong traps discharge both,* at steam temperature, *as fast as they accumulate.*

2. ***Corrosion rears its ugly head.*** Oxygen and carbon dioxide are real trouble-makers. CO_2 gas goes into solution in condensate, forms carbonic acid and chews away at vulnerable metal sections. O_2 aggravates the situation. See Figure 2.

TABLE A—How air reduces steam temperature.

Gauge Pressure	Temp. of Steam with No Air Present	Temp. of Steam Mixed With Various Amounts of Air (% Air by Volume)	
		10%	30%
10.3	240.1	234.3	220.9
25.3	267.3	261.0	246.4
50.3	298.0	291.0	275.1
75.3	320.3	312.9	295.9
100.3	338.1	330.3	312.4

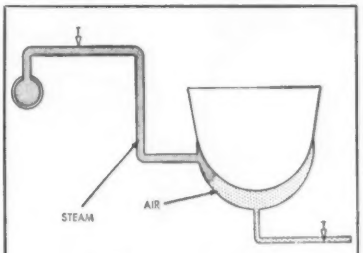


Fig. 3. *When steam is turned on, it takes a trap with extra air venting capacity to provide fast heat-up.*

3. ***Heat-up is slow as a snail.*** Air has a picnic in units that are shut off periodically. Figure 3 pictures the problem. Lines and equipment literally fill up with air. When the steam is turned on it can get in only as fast as the air gets out.

Enter Steam Traps

Curing these steam system ailments involves an operation sometimes called a "trap transplant." It consists of removing traps that don't get the air out and replacing them with traps that do.

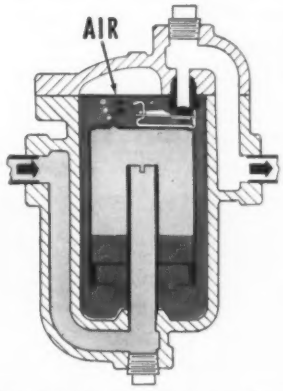
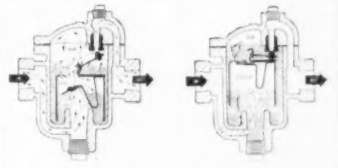


Fig. 4. *Air entering an Armstrong trap passes through the bucket vent and accumulates in the top of trap. When trap opens, air is discharged along with condensate.*

Figure 4 shows how an Armstrong inverted bucket trap continuously vents air. What the picture doesn't show is a built-in plus-value of this trap's design. An Armstrong trap opens suddenly, creating a momentary pressure drop and turbulence in the unit being drained. This breaks up air films and "pumps" air down to the trap so it can be vented.

The vents in standard Armstrong trap buckets will pass all the air normally encountered. In special cases, such as paper machine dryers, the vents are correctly sized larger at the factory to meet the requirement.



Thermostatic vent open. *Thermostatic vent closed.*

Fig. 5. *Open float with thermostatic vent for off-and-on units. When trap is cold, vent is open, permitting air to blow through when steam is turned on. When steam reaches trap, heat closes thermostatic vent. Then, regular bucket vent handles all air coming in with steam.*

Open Float with Thermostatic Vent

Super air-venting capacity is a must for fast heat-up of low pressure unit heaters, heating coils, steam headers and other units that are on-and-off. Figure 5 shows how the Armstrong open-float-with-thermostatic-vent trap takes care of this.

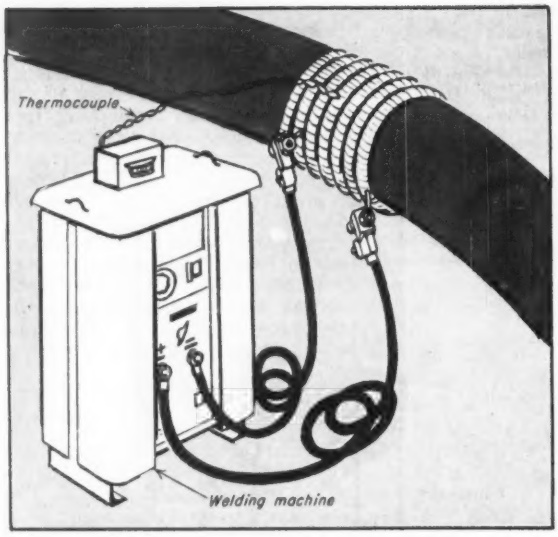
* * *

The 44-page Armstrong steam trap book covers other features of the Armstrong trap as well as its excellent air handling characteristics. This catalog also discusses trap selection, installation and maintenance. Your local Armstrong Representative or Distributor will be glad to give you a copy. Call him, or write Armstrong Machine Works, 8122 Maple Street, Three Rivers, Michigan.

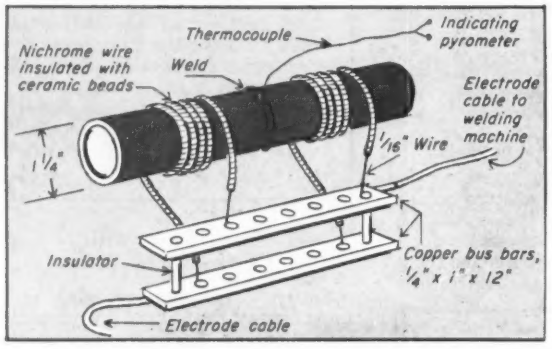
ARMSTRONG STEAM TRAPS

HOW TO

stress relieve pipe welds



Electric coils and welding machine are all you need



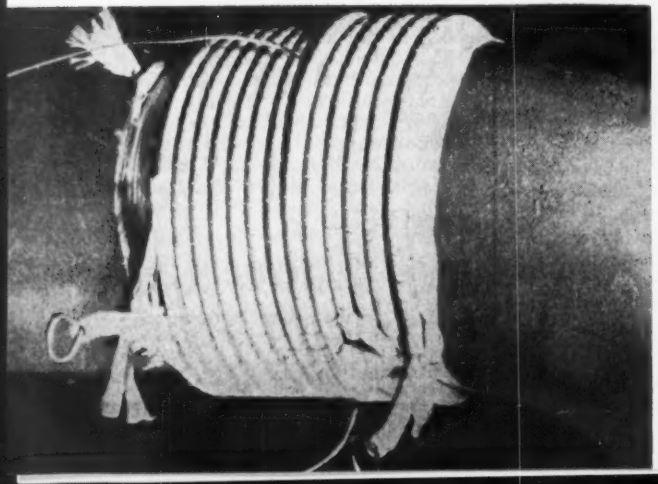
Single hookup is for stress relieving small diameter pipe

► NEW ELECTRICAL-RESISTANT heating element simplifies preheating and stress relieving of your pipe weld—and at a reduced cost. Known as the *Heat-O-Coil*, basic feature is a length of small-diameter resistance wire. Full length of wire, except for several inches on each end, is strung with ceramic ball and socket beads. Each end of coil is formed into a small ring. After wrapping coil around welded section of pipe for stress relieving, connect two ends to terminals on a welding machine.

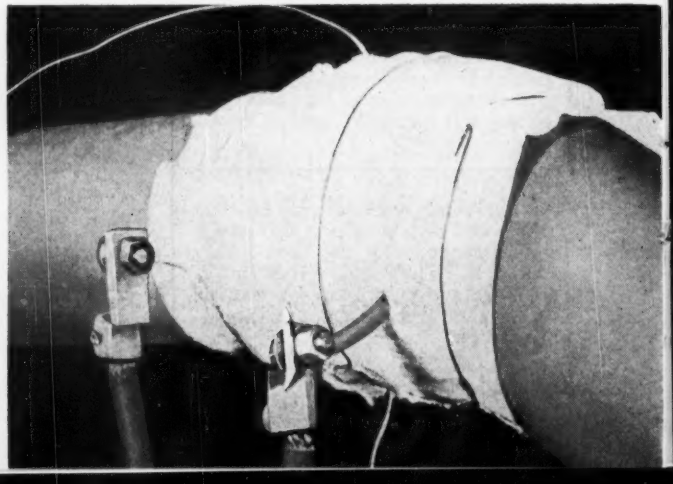
Insert thermocouples under coil and connect to an indicating pyrometer. After connections are made, wrap section being treated with an asbestos covering. When hookup is complete, set welding generator at amperage rate calculated to produce needed heat. Pipe thickness, heat required and general conditions affecting build-up heat vary with each job.

Soon as pyrometer shows that desired temperature is reached, adjust welding generator manually to hold correct temperature. Coils come in two standard diameters and lengths. For large diameter pipe, ⅛-in. coil is 25 ft long; for small diameter pipe, 1/16-in. coil is 10 ft long. It's also available in special lengths.—*Courtesy, Arcos Corp, 1500 S 50th St, Philadelphia, Pa.*

First, wrap coils in place around weld, hook to machine . . .



. . . then, wrap asbestos cloth around coils to hold heat in



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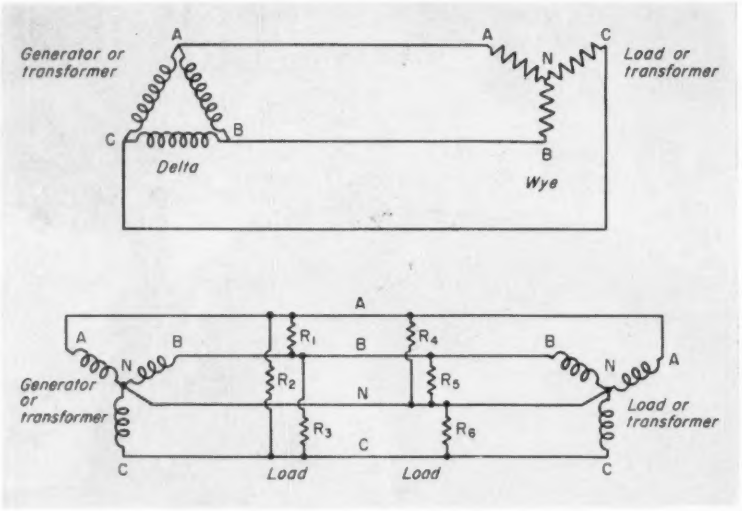
NORMAN PEACH, *Assistant Editor*



Electricity: 15

Common 3-phase circuits

► THREE-PHASE ELECTRICAL SYSTEMS transmit power through three wires as described in *Basics No. 12*, July 1957. It was shown that the 3-phase system consisted of three interconnected single-phase circuits. The three phase wires offer us two possible interconnections of circuit elements: the wye, in which three elements are connected together at one end, with the other ends each connected to a phase wire, and the delta, where opposite ends of two elements are joined and connected to a phase wire. The center point *N* of the wye connection makes possible the use of a fourth wire. Windings of generators can be connected either in wye or delta, (left, sketch above), and the load (such as motor windings, right) can also be either wye or delta. Similarly, transformer windings can be wye or delta. In order to have a balanced 3-phase system, the three elements in any wye or delta must have equal impedances. The branches of wye and delta connections can be parallel circuits provided impedances of the parallel elements are equal.

Current and voltage relations are different in branches of wye and delta connections. In the wye connection, line current flows through each branch of the wye. In the delta, line current divides between two branches, the proportion of instantaneous current depending on the phase angle. Effective, or root-mean-square (rms) current in each branch of the delta is $1/\sqrt{3}$ or 0.578 times line current. On the other hand, voltage across each branch of the delta is the same as line voltage, while voltage across each branch of the wye (that is, between a phase wire and the neutral point *N*) is 0.578 times line voltage. To convert a balanced wye connection into a delta connection with equivalent impedance, multiply the impedance of each branch by 1.73.

A 4-wire system can be created by connecting a fourth wire to the neutral *N* of a wye-connected generator or transformer. Three-phase power can be taken from phase wires *A*, *B*, *C*. Dual-voltage single-phase power is also available from the system, the higher voltage between any two phase wires (such as loads *R1*, *R2*, *R3* in sketch), the lower voltage between any phase wire and the neutral (loads *R4*, *R5*, *R6*). Typical dual-voltage single-phase systems have 120 volts between phase wire and neutral, and 1.73 times 120, or 208, between phase wires.

Balanced current in the phase wires is desirable, therefore the single-phase loads should be distributed between each phase as equally as possible. If loads *R4*, *R5*, *R6* are the same, they form a wye-connected load. Current does not flow in the neutral wire except for the short distances between the ends of the three loads; no current will flow in *N* back to the generator. If, however, *R6* draws more current than *R4* and *R5*, current will flow in *N*, and a larger current will flow in *C* than in *A* and *B*. The current in *N* will be the difference between the current in *C* and the current in *A* and *B*. Each load, *R4*, *R5* and *R6*, can be made up of many parallel loads, such as individual electric lamps, as long as the impedances of *R4*, *R5*, *R6* are equal. (The impedance of each of the three loads must have the same proportion of resistance, inductive reactance, and capacitive reactance. Equal loads *R1*, *R2* and *R3* form a balanced delta.

Next month's Basics: Parallel ac circuits.

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GA32/57/1

"I spread the CO_2 charts around the crystal ball to help me do some high-powered trouble-shooting," roared Marmaduke

Marmy's bouncing CO_2

► O'HOULIHAN's Machine Shop & Engine Works over in the Hell's Kitchen section of Manhattan was vibrating with activity when I looked in this morning. Not seeing Marmaduke, I climbed the creaky wooden steps to his office above.

The door was wide open. Inside, the old gent was anchored to his swivel chair, puffing away at a piece of rope yarn and scribbling in a battered ledger. As usual, his buddies were on hand drinking coffee and shooting the breeze. Sounded like an argument about the future power engineer 75 years from now or something.

Stepping into dense tobacco smoke, I recognized John Silvers, Snifty McSpadden, George Greene, Gus Kramer and Frank O'Toole. Kramer argued that in the year 2035 the plant engineer's secretary will do all the operating by flipping an electronic switch with her little finger.

"BILGEWATER on 2035," suddenly roared the old consulting engineer, throwing down his pencil and hoisting his size-16 canal boats up on his roll-top desk. "I'll tell you guys how I found the cause of a boiler's disappearing CO_2 in the year 1925. And all I did was use a little astronomy, the local newspapers and a crystal ball."

That did it. The chatter stopped. I found a seat and gave my undivided attention to this unusual consulting engineer. If there was any connection between CO_2 readings and astronomy, I had not heard of it. The other listeners registered something more than their usual befuddled look, but were too smart to question the cantankerous engineer.

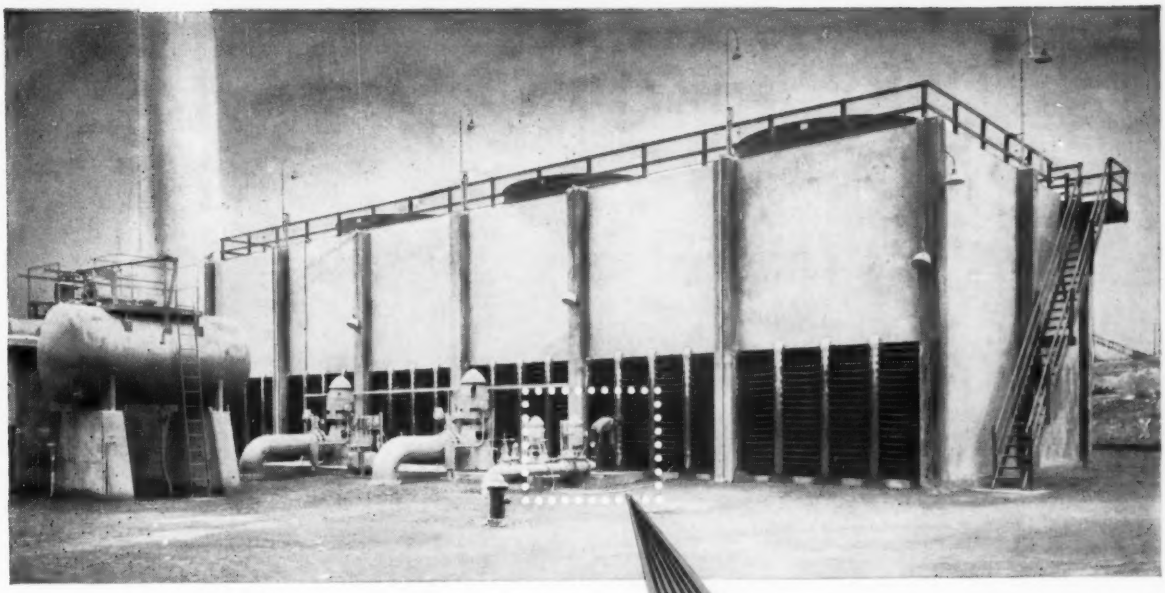
Marmy gave his old gray bowler the usual starboard list, puffed furiously at his cigar butt, then leaned back in his swivel chair. "Back in 1925 I pulled into Barranquilla, Colombia aboard a tramp freighter," he roared in his foghorn voice. "That evening I was busy at the Corozol Bar, explaining the science of combustion to Loletta. Carmeletta and Rosetta. They were the owner's three classy daughters. Suddenly my old shipmate Charlie Van Dueursen, chief of the tanker *SS Bisso*, walked in. Before we could shake hands, a native at a nearby table greeted Charlie. He was Roberto Sanchez, chief engineer of the local power plant. We all moved to a big round table, with the girls sitting between us. I had the drinks set up.

"'You look like you got some delicate part of you caught in the gears, Chief,' said Charlie to Sanchez after we had wet our whistles.

"'So would you if you had my problem, Señor,' answered Sanchez sadly. Here's the screwy story the chief told between rounds of drinks:

"His plant generated electricity for the city; was known as the Planta Loma. Machinery was a hodge-podge of diesels, a uniflow steam engine, two steam turbines and an old corliss. Steam pressure was 240 psi, supplied

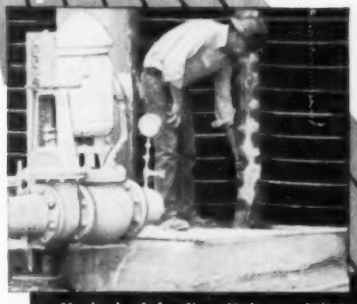
(*Continued on page* 210)



Unusual Cooling Tower

gets proven *Nalco* protection

This unusual cooling tower was built for the Riverside Cement Company at Oro Grande, California. The advanced design provides for concrete exterior walls which support and enclose fan units and redwood interior cooling vanes . . . The entire "working sections" of the tower can be repaired or replaced without affecting the structural strength of the shell. Nalco System Treatment protects this cooling system against scale and corrosion — has protected it effectively since it was first put in operation over two years ago. You can get the same complete water treatment protection, promptly, from Nalco. Write for details.



Method of feeding Nalco stabilizing treatment to this system is simplicity itself. Formula is supplied in ball form. Once each shift a perforated tube suspended in the tower basin is filled with balls which slowly dissolve in the cooling water.

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JENKINS PRACTICAL PIPING LAYOUTS 79

How to plan piping for

AN ARTIFICIAL ICE SKATING RINK

In the increased construction of skating rinks during recent years, a closed system with a balance tank located at its highest point has been commonly installed. The piping layout presented here utilizes such a system.

This system is suitable for any of the common brines. Calcium chloride brines are the most common, but others of a non-corrosive nature are frequently used. The cooling medium, which is circulated in the rink coils to freeze the water into ice, is usually chilled by a multiple Ammonia or Freon refrigeration installation like the system in the diagram. Coils carrying the ice-making brine are generally 1″ or 1¼″ iron or steel pipe on 4″ centers, with welded connections. Each coil loop is shown with a globe valve for control and shut-off at one end. A gate valve provides for shut-off and complete isolation of the individual coil at the other end. Each coil has an air vent.

Either or both of the two brine pumps may be used, depending on specific conditions and requirements. In addition to the brine circuit, the cooling water circuit to the condenser and compressors is diagrammed. Ordinarily, valves in this cooling water circuit are bronze or iron body bronze mounted.

For systems handling corrosive brines, such as calcium chloride, all-iron valves are specified because of the destructive action of such brines on non-ferrous valves. For systems using non-corrosive brines, bronze or iron body bronze mounted valves are recommended.

Where gate valves are specified for shut-off services, rising spindle types, which indicate wedge position, have been chosen.

The sturdy Jenkins Fig. 241 O.S. & Y. U-Bolt all-iron gate, is favored by engineers and contractors for corrosive brine systems. The outside spindle design prevents thread destruction by fluids in the line and facilitates cleaning and lubrication. The reversible, solid malleable iron wedge slips onto the spindle T-head, and is free floating, assuring automatic adjustment to the seats for tight closure.

Jenkins Fig. 106-A renewable composition disc bronze globe valve is recommended for installation on individual coils, brine coil air vents, and for other regulatory services where accurate flow control and drop-tight closure are essential. Tight closure for a lifetime of service is gained merely by renewing the disc in a Fig. 106-A . . . a simple job because of the unique Jenkins slip-on, stay-on disc holder.

To assure efficiency in the job when planning any major piping installation, consult with accredited piping engineers and contractors.

To make certain of trouble-free, economical valve performance, select your valves from the Jenkins Catalog. It shows types and patterns, made of different metals for an endless variety of needs.

For prompt, capable help when you want Jenkins Valves and other supplies for your job, call the top-flight distributor who represents Jenkins in your city.

Fig. 241
ALL IRON GATE

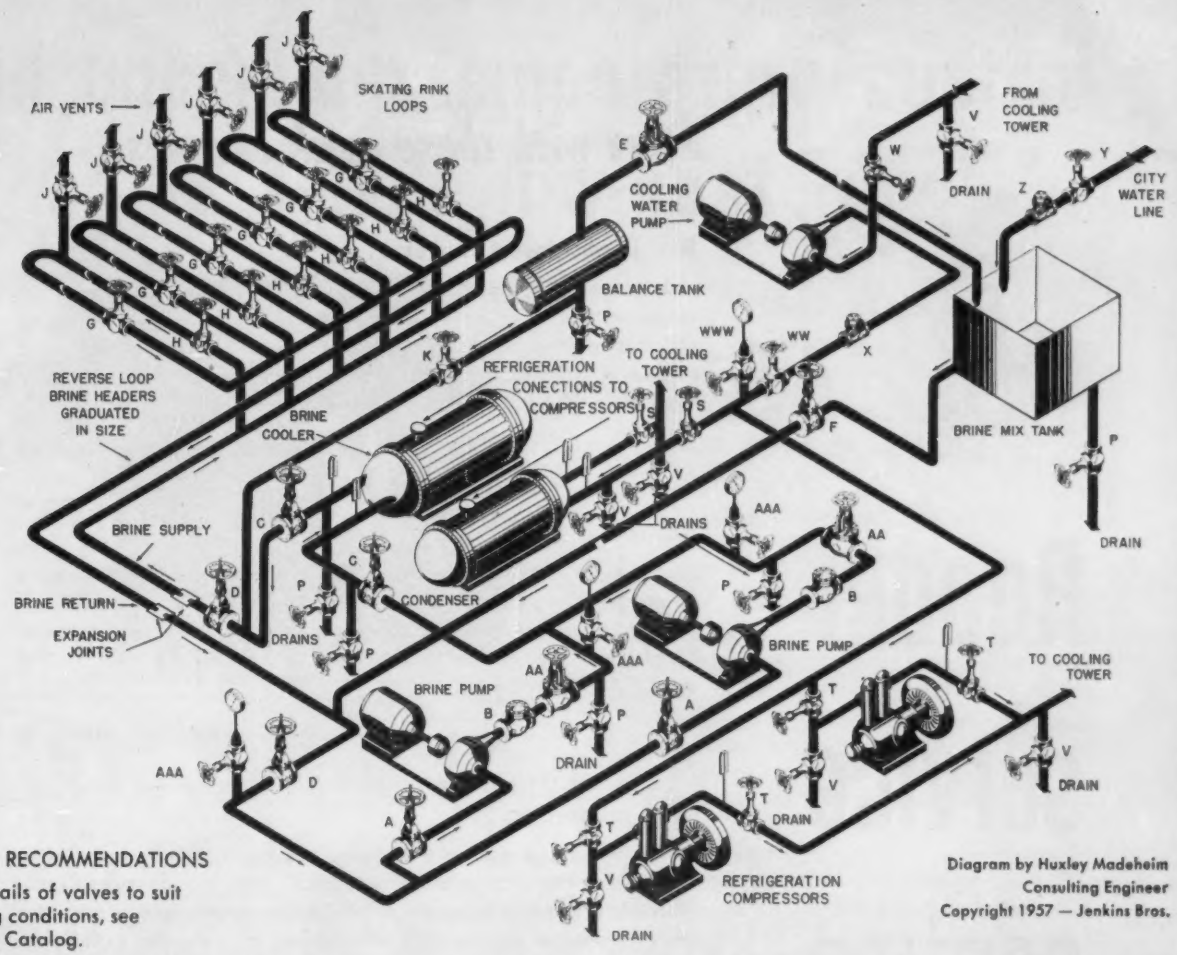
for 200 lbs. non-shock cold O. W. G. with outside screw and yoke . . . U-bolt . . . rising spindle . . . automatic adjusting solid wedge and other Jenkins trouble saving features.

JENKINS BROS.
100 Park Avenue, New York 17
Send descriptive folder 189-A on Fig. 106-A Bronze Globe Valves.

Name.....

Company.....

Address.....



VALVE RECOMMENDATIONS

For details of valves to suit varying conditions, see Jenkins Catalog.

Diagram by Huxley Madeheim
Consulting Engineer
Copyright 1957 — Jenkins Bros.

		Non-Corrosive Brines	Corrosive Brines	
Code	Quan.	Jenkins Valves	Jenkins Valves	Service
A	2	Fig. 651-A IBBM	Fig.241 All Iron Gate	Brine pump flow shut-off
AA	2	Fig. 142 IBBM	Fig.81 All Iron Globe	Brine pump flow control
AAA	3	Fig. 106-A Bronze	Fig. 75-A All Iron Globe	Brine pump pressure gauge
B	2	Fig. 624 IBBM	Fig. 85 All Iron Swing Check	Prevent backflow through brine pump
C	2	Fig. 651-A IBBM	Fig. 241 All Iron Gate	Shut-off chiller brine flow
D	2	Fig. 651-A IBBM	Fig. 241 All Iron Gate	Brine to rink shut-off
E	1	Fig. 142 IBBM	Fig. 81 All Iron Globe	Brine balance tank overflow control
F	1	Fig. 651-A IBBM	Fig. 241 All Iron Gate	Brine flow shut-off at tank
G	(1 each)	Fig. 106-A Bronze	Fig. 75-A All Iron Globe	Control brine flow in individual coil
H	(1/coil)	Fig. 47-U Bronze	Fig. 240 All Iron Gate	Shut-off brine flow in individual coil
J	(1/coil)	Fig. 106-A Bronze	Fig. 75-A All Iron Globe	Control brine coil air vents
K	1	Fig. 106-A Bronze	Fig. 81 All Iron Globe	Brine balance tank flow control
P	6	Fig. 106-A Bronze	Fig. 75-A All Iron Globe	Control brine drains

Code	Quan.	Jenkins Valves	Service
S	2	Fig. 47-U Bronze Gate	Shut-off condenser cooling water
T	4	Fig. 47-U Bronze Gate	Shut-off compressor cooling water
V	6	Fig. 106-A Bronze Globe	Control fresh water drains
W	1	Fig. 47-U Bronze Gate	Cooling water pump flow shut-off
WW	1	Fig. 106-A Bronze Globe	Cooling water pump flow control
WWW	1	Fig. 106-A Bronze Globe	Cooling water pump pressure gauge control
X	1	Fig. 92-A Bronze Swing Check	Prevent backflow through cooling water pump
Y	1	Fig. 106-A Bronze Globe	Control water supply makeup
Z	1	Fig. 92-A Bronze Swing Check	Prevent backflow into water supply

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Reader service section

Start with these quick samples...

East is east, west is west . . .

and the twain are meeting in Nationalist China. Local engineers are combining traditional manual work methods with modern know-how and typical engineering ingenuity. They are using a bucket brigade to carry rock for a hydro project, because there just aren't any trucks available. More about this and other late developments in . . .

Reports from the field, p 152

Abstract art . . .

puzzles a lot of us. But there's no puzzle about the art of abstracting as practiced in *Technical briefs*. Here, *Power* editors scan the latest technical papers for you, boil them down for quick reading. Of course, if you prefer your art less "abstract" we've provided directions on how to order the full report.

Technical briefs, p 154

Life's made easy . . .

by the new equipment we're featuring this month. We have the latest labor-saving items for plant maintenance, including a smoke-density indicator, a vibration recorder, a self-filtering cleaner and a protective spray for outdoor storage piles. In addition, we're showing a field-conversion kit to uprate compressor hp, plus a whole set of lube items.

Plant equipment news, p 158

When winter comes . . .

we all like to pull up to the fire with a good book, and no one wants to go out in the snow to shop for new equipment. If you'll invest a 2c stamp, attach it to the post card we provide, and check off the trade bulletins you'd like to receive, we'll see that you're supplied with some good reading matter for those stormy winter days.

Free literature, p 167

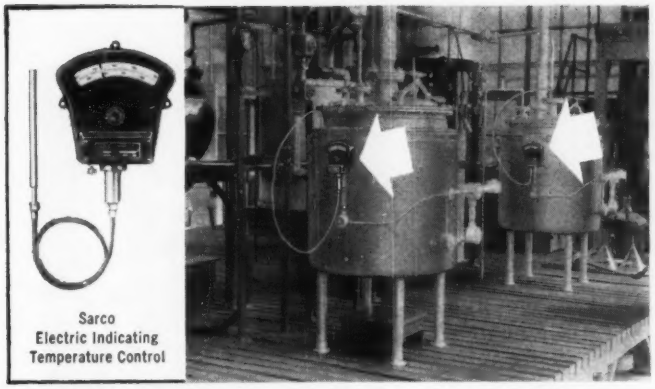
The plant "grapevine" . . .

can be responsible for a lot of trouble. Rumors are easy enough to start, but they can be harder than moonbeams to pin down once they're underway. There's a story about an old prospector who thought he'd start a gold-rush rumor, and wound up holding the bag. More about this, and a good working plan for scotching rumors, from

George Edwards, p 170

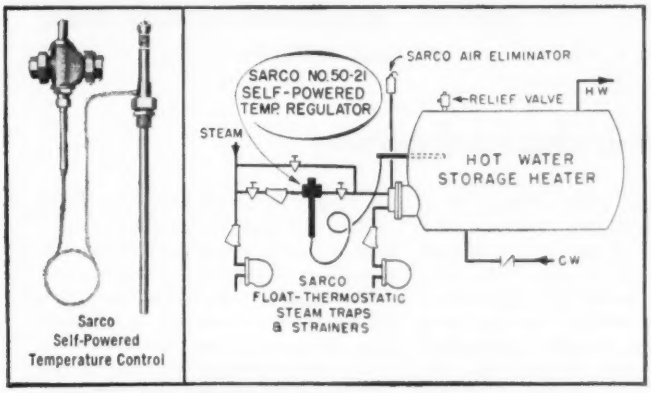
For other timely ideas, see following service pages

End uncertain temperature control this simple low-cost way



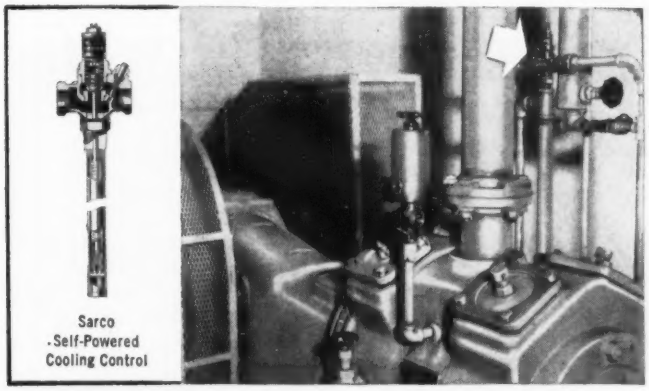
Sarco
Electric Indicating
Temperature Control

STILLS – jacket water temperature of stills held to within ± ½°F. *Other typical applications* – kettles, sterilizers, chemical tanks, plating tanks, processing vats, etc.



Sarco
Self-Powered
Temperature Control

HOT WATER STORAGE HEATER – desired water temperature is automatically maintained. *Other typical applications* – dryers, oil storage tanks, kilns, heat exchangers, etc.



Sarco
Self-Powered
Cooling Control

COMPRESSORS – controls temperature of cooling water, prevents overcooling and undercooling in compressors, aftercoolers and intercoolers. *Other typical applications* – small engines, condensers, ball mills, water-cooled bearings, lubricating oil coolers, etc.

SARCO Automatic Temperature Controls

Electric Indicating and Self-Powered

Simple—Dependable Inexpensive

YOU CAN get rid of costly, hit-or-miss manual temperature control . . . without investing in expensive equipment.

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Electric Indicating Controls by Sarco are simple, sensitive . . . perform many of the functions of much more elaborate recorder-controllers, at fraction of their cost. Responsive to temperature changes of ± ½°F. Cost . . . only about $100.

Sarco Self-Powered Controls need no outside power source. Self-contained. Packless. ½" size temperature controller . . . only about $100. ¾" size cooling control...only about $39.

Users of Sarco Controls include Colgate-Palmolive, Sinclair Refining, Swift, Ingersoll-Rand and hundreds of others.

WRITE FOR BULLETINS

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No. 620 – Self-powered Temperature Controls

No. 710 – Self-powered Cooling Controls

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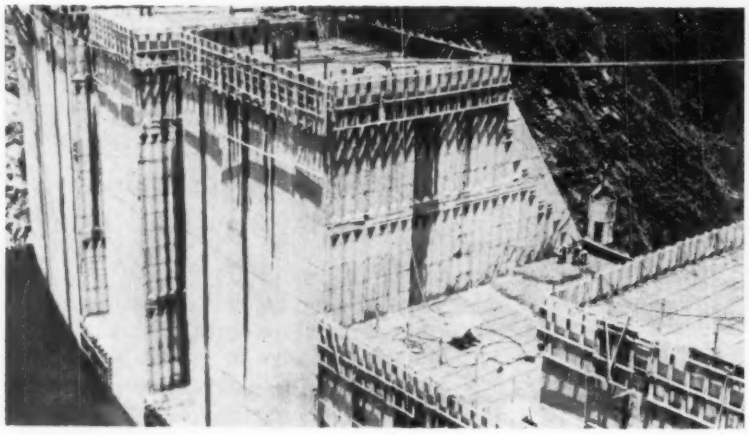
ELECTRIC INDICATING AND SELF-POWERED TEMPERATURE CONTROLLERS • STEAM TRAPS • STRAINERS

REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 238



MODERN WU-SHEH DAM is built with rock brought 21 miles by aerial cableway *right*

2000 WORKMEN use new, old methods

Free China ups industrial power

Utilizing modern engineering know-how, traditional manual work methods and make-shift transportation, Nationalist Chinese engineers at Wan-Ta, Formosa combine the new with the old in a way that might surprise theorists—they are finishing a hydroelectric project designed to provide a total increase of 40,000 kw for island industries.

The Wu-Sheh hydro project on a tributary of the Choshi River has been under construction for four years, and should be finished in July, 1958. Formosa has an essentially agricultural economy, so this station is a major step in the Chiang Kai-shek "operation bootstrap" to boost industry and stabilize the economy of the 10 million inhabitants of the free Chinese island.

Dam will be 374 ft high and create a lake 3½ miles square with 14 miles of shore line. Aided by $10 million and three consulting engineers from U.S. International Cooperation Administration, China still found this project literally tough sledding. No rock, cement or suitable (*Continued on page* 233)

Power Lines

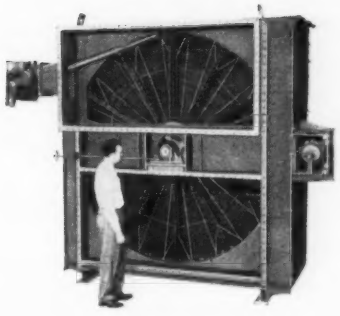
Big step toward fully automatic control of an entire power plant has been made with installation of "operational information system" at the new 200,000 kw unit of Sterlington Steam Electric Station of Louisiana Power & Light Co. Developed by Ebasco Services, Inc, system uses transistorized digital computer to cover measurements at 350 points; automatically log 100 points per hour. (See POWER, April 1957, p 73-79 for staff roundup on automatic data loggers.)

U.S.-Canada agreement for development of Columbia River hydro power was urged by U.S. Chamber of Commerce president Philip M Talbott, in a speech at Victoria, B.C. International study of hydro potential of Yukon River basin in Canada and Alaska was also proposed; joint development by government and private industry of both countries advocated.

National Bureau of Standards has measured textural stresses in metals with x-ray. They've demonstrated the impossibility of obtaining completely stress-free condition in metals containing more than one phase.

Hungarian power plans, disclosed last fall (POWER, Dec. '56), are being speeded up. First atomic reactor, described as medium sized, is scheduled for completion by next summer. Meanwhile, a 50-mile cable will import approximately 100 million kwhr of Yugoslav surplus electrical power for Hungarian use.

U.S.S.R. is building world's first solar power station in Armenia. Plant is designed to produce 2,500,000 kw of electricity a year. Cauldron with 1300 reflector mirrors moving on circular rails will heat water to boiling point, producing steam to power turbine.



HOW MANY STACK BTUs DO YOU BUY EACH YEAR?

Whether you burn it — or dissipate it up the stack — every BTU costs you money. In fact:

Yearly cost of fuel often equals the cost of your boiler. That's why heat recovery—or dollar recovery—is so important. Boilers simply have huge appetites for fuel . . . fuel that's constantly going up and up in cost.

And small boilers are no exception. Even with relatively small boilers—that is, between 25,000 and 250,000 lbs per hr—substantial heat recovery is possible. With a Package Ljungstrom Air Preheater, fuel consumption is most often reduced 10% or more! As a result, many plants have written off their Ljungstrom within two years.

Get more steam, and cleaner stack gases. Put it another way. The BTUs that you save with a Package Ljungstrom can be used to increase boiler output. What's more, higher combustion temperatures cut slagging . . . keep stack gases clean . . . allow use of cheaper fuels . . . reduce corrosion.

Comes complete, ready to install. Determine for yourself how easily a low-cost, *shop-assembled* Package Ljungstrom can be applied to your generating or process system. Ask for our brand-new 16-page brochure. It's yours with our compliments, simply by writing to the address below.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

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ELECTRICITY
ATOMIC ENERGY
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STANDARDS

Relay performance is improving

The dynamically and statically controlled magnetic amplifier as a multipurpose relay. *By J Baude, Allis-Chalmers Mfg Co.*

It is possible with the help of a magnetic amplifier to greatly extend the function of a simple relay or the combination of different types of relays. This is accomplished by arranging various control windings of the amplifier in such manner that alternatively or simultaneously the dynamic as well as the static characteristics of the amplifier will be used for purposes of control signal intelligence discrimination.

The control characteristics described above would be especially useful for applications where variable control signal frequency plays an important role. The following are some examples of such applications: (1) synchronous motor field application and cage winding protection (2) low cost generator-to-power system synchronization and automatic governor motor impulse controls (3) any other electrical system which can be based upon variable frequency or impulses. *AIEE paper, No. CP 57-3.*

Interim report on revisions to relay standards. *By Relay Standards Subcommittee of the AIEE Committee on Relays (Power Group).*

The American Standard for "Relays Associated with Electric Power Apparatus" C37.1-1950 is being reviewed by a subcommittee of the AIEE Committee on Relays. The main purpose of this review is to expand the section on performance terms and to ultimately prepare a new section on performance standards.

While working on this basic problem, the subcommittee realized that further improvements could be made in other sections of this 1950 revision of the standard. These improvements fall into three general areas: (1) additional definitions (2) revised definitions (3) rearrangements of the basic format of the Standard into a more functional form. Many of these improvements are included in this interim report. *AIEE paper, No. CP-57-71.*

A new line of protective relays and cases. *By J L Blackburn and W E Glassburn, Westinghouse Electric Corp.*

A redesign program was undertaken to reduce size of protective relays and improve accessibility to the relay operating units. In addition to the concept of reduced size, these other important concepts were given renewed emphasis in this redesign program: (1) designs built around a minimum number of standard basic units (2) self-containing each relay type within the relay housing (3) unit designs of self-aligning parts (4) minimum adjustments (5) designs for universal application to reduce varieties.

These concepts form the basic design philosophies underlying the new lines of relay cases, the induction time overcurrent, directional time overcurrent and induction time voltage relays described in this paper. The results are modern protective relays of compact size, reliable performance, minimum maintenance. *AIEE paper, No. 57-18.*

Electricity

High speed magnetic air breaker for distribution circuits. *By H P Sleeper, Public Service Electric & Gas Co, and J D Findley, Westinghouse Electric Corp.*

Field tests indicate that very fast clearing of faults on 4 kv open-wire distribution circuits will reduce wire burndowns materially and consequently improve the service interruption record. Heretofore, the fastest air breakers available for this service, exclusive of compressed-air breakers, have interrupting times of 3½ to 5½ cycles. A magnetic air breaker with 1½ to 2 cycles interrupting time is now available. These interrupting times approach those of line reclosers that have proved extremely satisfactory in preventing burndown of overhead distribution conductors. *AIEE paper, No. CP 57-170.*

840 cycle fluorescent lighting. *By R H Burnham, The Wakefield Co.*

Increasing frequency for the purpose of operating fluorescent lamps under more advantageous conditions seems to be practical with electrical components available today.

It appears that a high-frequency system boasting of increased efficiency and lamp life, reduced radio interference, elimination of stroboscopic effect, removal of ballast noise, reduction in number and size of lighting fixtures could be installed for the same overall cost as the usual 118-volt 60-cycle system. Under favorable conditions high-frequency lighting may reduce the electrical contract by 10 to 15%.

The electroluminescent luminous panel light source increases in brightness with both an increase in frequency and voltage. Probably when this new light source becomes practical for general use, it will be used first on a high-voltage high-frequency distribution system. *AIEE paper No. CP 57-34.*

Design features in a new line of outdoor oil circuit breakers rated 14.4 to 69 kv. *By F B Johnson and G B Cushing, Westinghouse Electric Corp.*

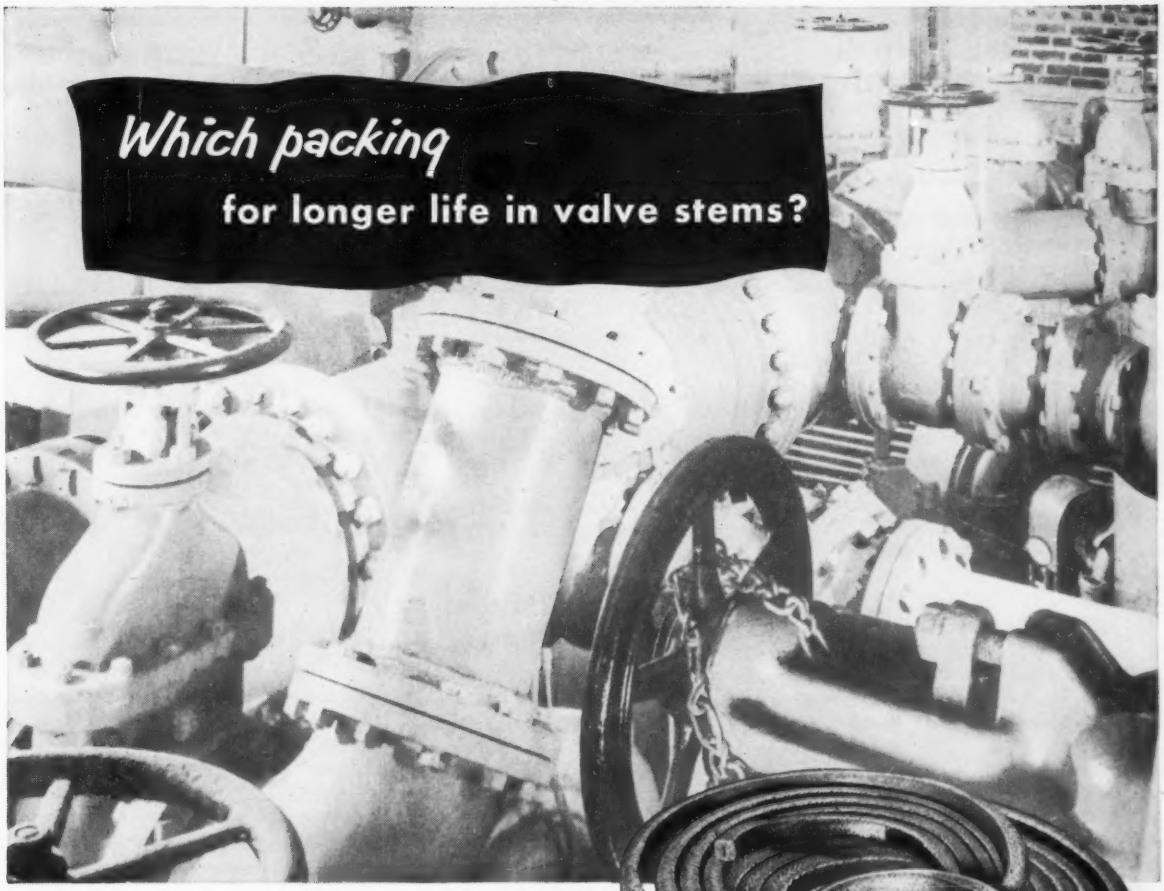
This paper describes the design features and tests of a new concept in oil circuit breakers conforming to the requirements of the present standards but imposing the minimum maintenance burden on the user. The breakers afford such important engineering advantages as reduced oil volume, standardized bushings, simplified mechanical systems and improved interrupting performance. Interrupting ratings as high as 2500 mva are available with interrupting time as short as 5 cycles.

A total of fourteen different ratings are involved. But common parts have been employed wherever possible, in the interest of maintaining an economic design. *AIEE paper, No. 57-175.*

Stability limits of a synchronous motor. *By F C Tormollan, University of Texas.*

Paper presents results of a study to determine the additional load that can be suddenly applied to a 3-phase synchronous motor without exceeding stability limit of the system and thermal limit of the motor. The motor is assumed to be supplied from an infinite bus through an external impedance, and resistance is neglected in the external impedance and in the motor. The motor

Which packing for longer life in valve stems?



. . . for heavy fluids, steam, water and gas . . . *it's J-M Jewett*®

Strong, tough Jewett has been proven the ideal packing for heavy duty valve stem service against crude and heavy oils, tar, molasses and other heavy gummy fluids. It also provides efficient sealing against steam; fresh or salt, hot or cold water; air; gas and some chemicals requiring a packing free from rubber.

The basis of Jewett's exceptional durability is its construction of high-quality long fibre asbestos yarn with fine copper wire inserts. This yarn is braided over a lead ribbon core and formed square. Style 10 is treated with a heavy bodied, heat-resisting lubricant which won't bleed in valve stem service. Furnished graphited in coil or ring form in sizes from ⅛″ up.

. . . for superheated steam and gases to 1200F *it's J-M High Temperature*

When valves are operating in high temperature service, your best packing choice is Johns-Manville High Temperature Style 397. It retains its resilience, holds a tight, lasting seal against superheated steam and dry gases under elevated pressures and temperatures up to 1200F.

To obtain this high sealing efficiency, Johns-Manville braids asbestos yarn of high purity over a plastic core of special heat resistant composition. For extra strength, the yarn is reinforced with tough heat and corrosion resistant Inconel wire. The packing is formed square and then lubricated with graphite. Furnished in ring, coil and spiral form in sizes ¼″ to 1″.

Your local J-M distributor carries full stocks of Jewett, High Temperature and other packings. Call him today or write Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

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More TECHNICAL BRIEFS

Begins on page 154

is assumed to be operating at synchronous speed, rated voltage and any initial load between no-load and full-load, when the additional load is suddenly applied.

In determining the maximum additional load that can be applied with stability, the system is assumed stable if (1) synchronism is not lost on the first swing of the motor and (2) it is stable under steady-state with the added load. Author feels the methods are of general application. *AIEE paper No. CP 57-205.*

Representation of induction motor loads during power system stability studies. *By D S Brereton, D G Lewis and C C Young, General Electric Co.*

This paper presents a discussion of the various methods of representing induction motor loads during power system stability studies. Results of computer studies of the motor behavior under various assumptions are included so proper representation for a given set of system parameters may be determined. In addition, step-by-step methods for calculation of transient behavior of the induction motor suitable for either an ac network analyzer or a digital computer are developed. *AIEE paper No. 57-159.*

Atomic energy

The economics of boiling water reactors. *By O B Falls Jr, General Electric Co.*

It appears that, irrespective of what type reactor we might consider, there is no reactor that (size for size) has any chance of being manufactured at a first cost equal to or lower than conventional plant boilers, within the next 5 to 8 years. In fact, the end date might be 10 or 15 years. Furthermore, our present estimate of the operating and maintenance expenses of even the simplest nuclear plants indicates that they will be much higher than costs in conventional plants. It will be a long time before these expenses can be reduced to the level of conventional plants.

The present costs of nuclear fuels are expected to come down rapidly, far more rapidly than fossil fuel costs, but the author does not believe they will reach the same level as conventional fuels within the next five years.

He concludes that while the short range outlook for making atomic electric power economically competitive is rather bleak, development of this source of power must take a vital spot in the industry so the U. S. can have at its command the power it needs to continue to grow and prosper. In the long run, we can look forward to atomic electrical power that will be cheaper and more abundant than the conventional power of today. *AIF paper, no number.*

The availability of world-wide energy and economic information. *By Karl Mayer, Stanford Research Institute.*

Purpose of this paper is to survey briefly the general availability of energy information and to point out areas of interest to the atomic industry where data voids or data pitfalls exist. This presentation is broken into four main sections: (1) a review of available data and sources (2) needs for additional raw data (3) needs for data analysis, synthesis and interpretation (4) industrial value of information properly collected and analyzed.

The paper includes a list of selected sources of energy information, and a detailed analysis of the kinds of data useful in making nuclear power market studies. *AIF paper, no number.*

Basic equations for predicting performance of a nuclear power plant pressurizer. *By T H Glasser, Knolls Atomic Power Laboratory.*

This analysis provides a set of differential equations from which system pressure as a function of time can be calculated. Solution of these equations have been carried out on an IBM-650 computer for various temperature inputs. These equations can be used not only to simulate performance of an existing pressurizer but also in sizing calculations for a new pressurizer.

In sizing calculations it is necessary to determine overall size of the vessel, ratio of steam volume to water volume and spray ratio. Many repeated calculations are necessary to determine the effects of varying these parameters in arriving at an optimum design. Advantage of having a computer carry out these calculations is obvious. *ASME paper No. 57-NESC-95.*

Radioactive process ventilation. *By S H Glassmire and J P Whalen, University of California.*

This paper summarizes the unique ventilation requirements of laboratories handling radioactive materials. The Chemistry and Metallurgical Research Building at Los Alamos Scientific Laboratory of the Atomic Energy Commission is a typical example of a building incorporating these unusual design considerations. This report shows the ventilation design and operational data of this building.

Other ventilation considerations and problems of concern in the atomic energy industry—for example, ventilation of nuclear reactors, ventilation of ships and aircraft using nuclear fuel and ventilation of atomic bomb shelters—are briefly mentioned. *ASHAE paper, no number.*

Heating, ventilating

Outlet characteristics that affect the downthrow of heated air jets. *By L Helander, S M Yen and W Tripp, Kansas State College.*

Authors show that either or both of two effects—(1) an increase in the downthrow and (2) increase in the thermal spread of the jet—are realizable by modifications in design of a downward-discharge unit heater with an outlet of fixed diameter. Conditions are (1) modifications must increase the down-thrust (projectile force) at the outlet or (2) modifications must increase the product of buoyancy number multiplied by relative thrust.

Relative thrust is defined as the actual thrust divided by the thrust calculated for zero gage-static pressure and a uniform velocity at the face of the outlet. Values of the thrust and relative thrust developed by typical outlets are given, and data on the effects of cores and guide vanes on these values are presented.

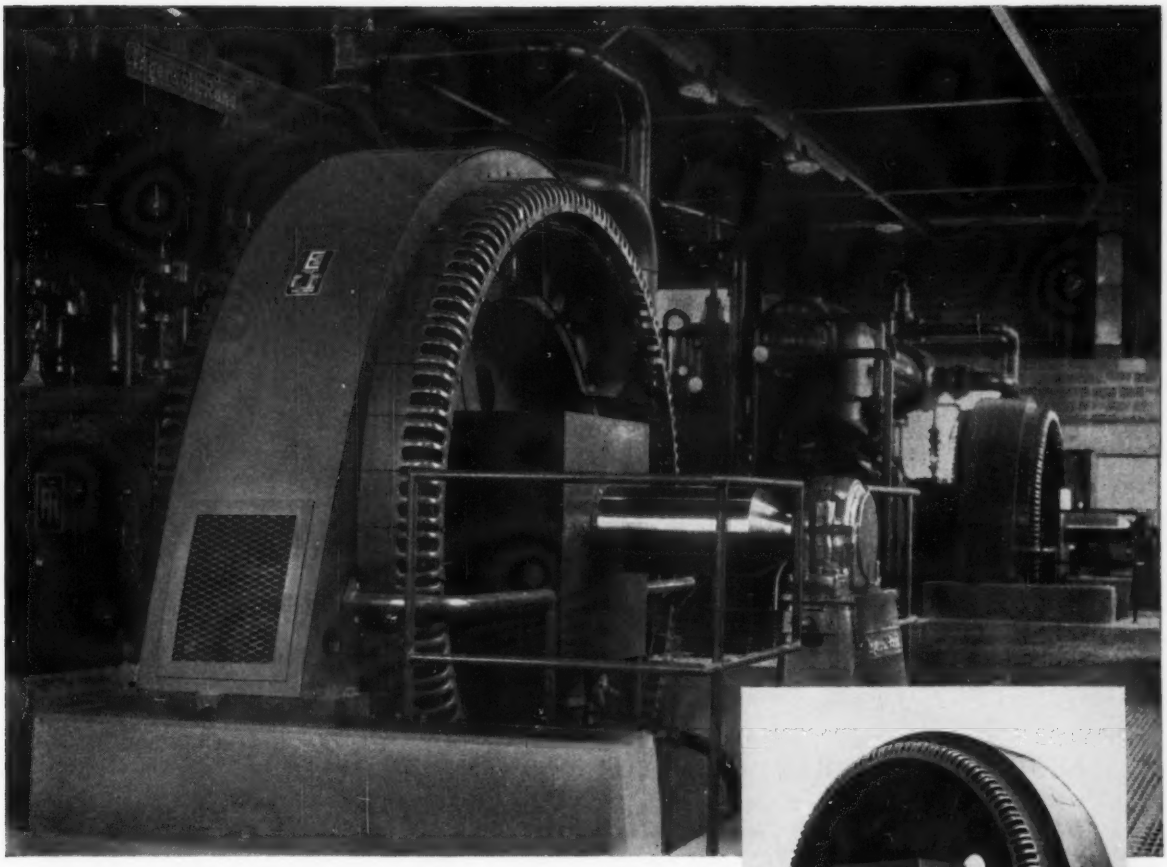
The data on relative thrust have guidance value for estimating the thrust-developing capability of outlets of the types investigated. A simple means for measuring the thrust developed by an outlet is described. *ASHAE paper, no number.*

Air flow in free convection over-heated bodies. *By T F Hatch and D Barron-Oronzco, University of Pittsburgh.*

Material in this paper can be used as a basis for determining exhaust ventilation requirements for hot processes in industry. The authors report results of a laboratory study of free convection flow past heated bodies. Objective was to relate the magnitude of flow at var-

(*Continued on page* 197)

Directions for ordering papers on page 204

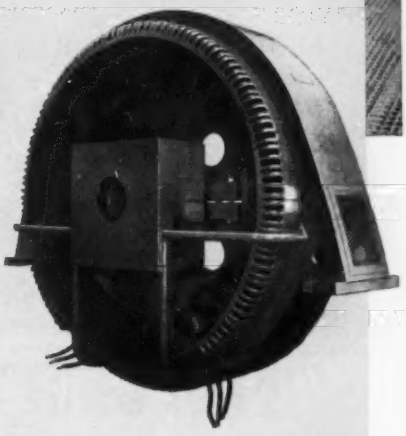


Large Elliott Motors power unique compressor installation

In a New England chemical plant, two 3500-hp, 300-rpm Elliott synchronous motors furnish the power to drive compressors which are the heart of an ammonia process. The unique feature of the installation is that the compressors each provide *four* services, one more than has ever been attempted before.

The motors are started across the line, being brought up to speed and field-applied in four to five seconds with a minimum of disturbance to the system voltage and a momentary frequency drop of less than 0.5 cycle. An Elliott 7500-kw turbine-generator, operating as an isolated unit, is used for starting.

Elliott offers broad experience in many fields of motor applications to assist users in achieving greatest economy and dependability of service. Consult the nearest Elliott District Office, or write Elliott Company, Ridgway Division, Ridgway, Pa.



Built to stand up on the toughest jobs

The rigid Fabristeel construction, unequalled insulation protection and other features of Elliott large motors give them the stamina to withstand the most severe service. The motor shown above is one of those installed in the plant illustrated in the photograph at the top of the page. Its rugged construction is apparent.

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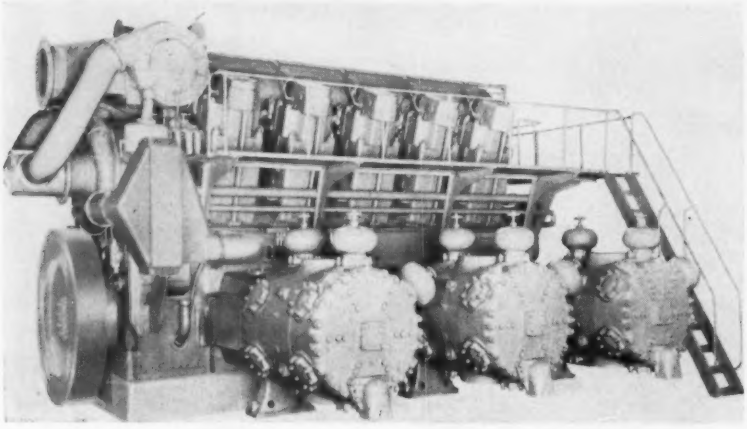


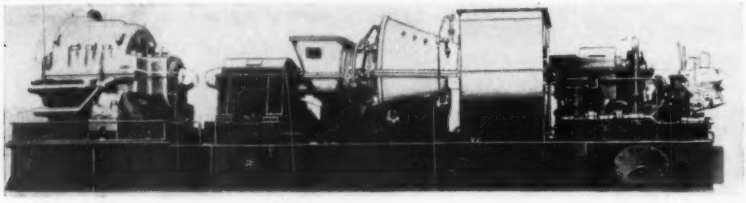
Field-conversion kit uprates compressor hp

1101 • Unit can substantially increase hp ratings of many 2-cycle engine-driven compressors and improve fuel economies, manufacturer states. Engine auxiliary capable of being mounted on new as well as older engines was designers' aim. Hp increase is said to be 22-to-50%, depending on engine type.

Kits provide uprated engines with greater overload capacity. Engines no longer have to be derated for altitude, and better conversion of heat to usable power is also claimed, with fuel consumption as low as 6900 Btu/hp/hr.

Conversion units provide parallel or series turbocharging systems. Parallel type is all exhaust-driven unit that compliments existing engine reciprocating scavenging pumps. Series kit is introduced into engine air-intake system as a first stage of compressors, photo above. With series arrangement, engine is supercharged from starting moment through all speeds and loads, maker claims.

The Cooper-Bessemer Corp, 200 Thomas Ave, Mt. Vernon, Ohio.



3250-hp gas turbine features quick starting

1102 • Unit is designed for use as a mechanical drive for pumps, compressors or generators, according to manufacturer. Simple, open-cycle turbine operates at 8500 rpm; any output speed can be obtained through use of gearing. Unit is said to reach operating speed in less than three minutes.

At full load, exhaust flow is about 191,000 lb per hr at 775 F. Unit is 21-ft long, 6-ft wide and 4½-ft high; weighs 14,000 lb. Package of turbine, driven apparatus, starting equipment auxiliaries and controls comes mounted on common bedplate. Unit incorporates split casing and two-bearing construction. Minimum of operating personnel is required due to fully automatic protection and semiautomatic starting and stopping controls, according to manufacturer.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

Free-piston engine lube

1103 • High load-carrying lubricant is designed expressly for trouble-free cylinder lubrication of free-piston gas generators, maker states. Oil is said to minimize ring and cylinder liner scuffing and scoring, rapid ring wear, deposit formation in engine case and on compressor delivery valves. It can also be used in gasifiers; reduction gear.

Shell Oil Co, 50 W 50th St, New York 20, N.Y.

Multipurpose lubricant

1104 • Lube is said to be applicable to plumbing and heating requirements as well as conventional grease-lubricated gearings and other machine elements. Retains normal texture, structure and consistency when subjected to extremes of heat and cold, maker claims, therefore can be used summer or winter.

J A Sexauer Mfg Company 2503 3rd Ave, New York 51, N.Y.

Production lube sprayer

1105 • Unit is designed for applying molybdenum disulfide lubricant. Lube comes packaged in self-pressurized 5-gal container with spray gun and 9 ft of hose. Gun has long nozzle, pistol-grip handle. Trigger action is adjustable to govern rate of discharge and spray pattern.

Tower Oil Co, 300 W Washington St, Chicago 3, Ill.

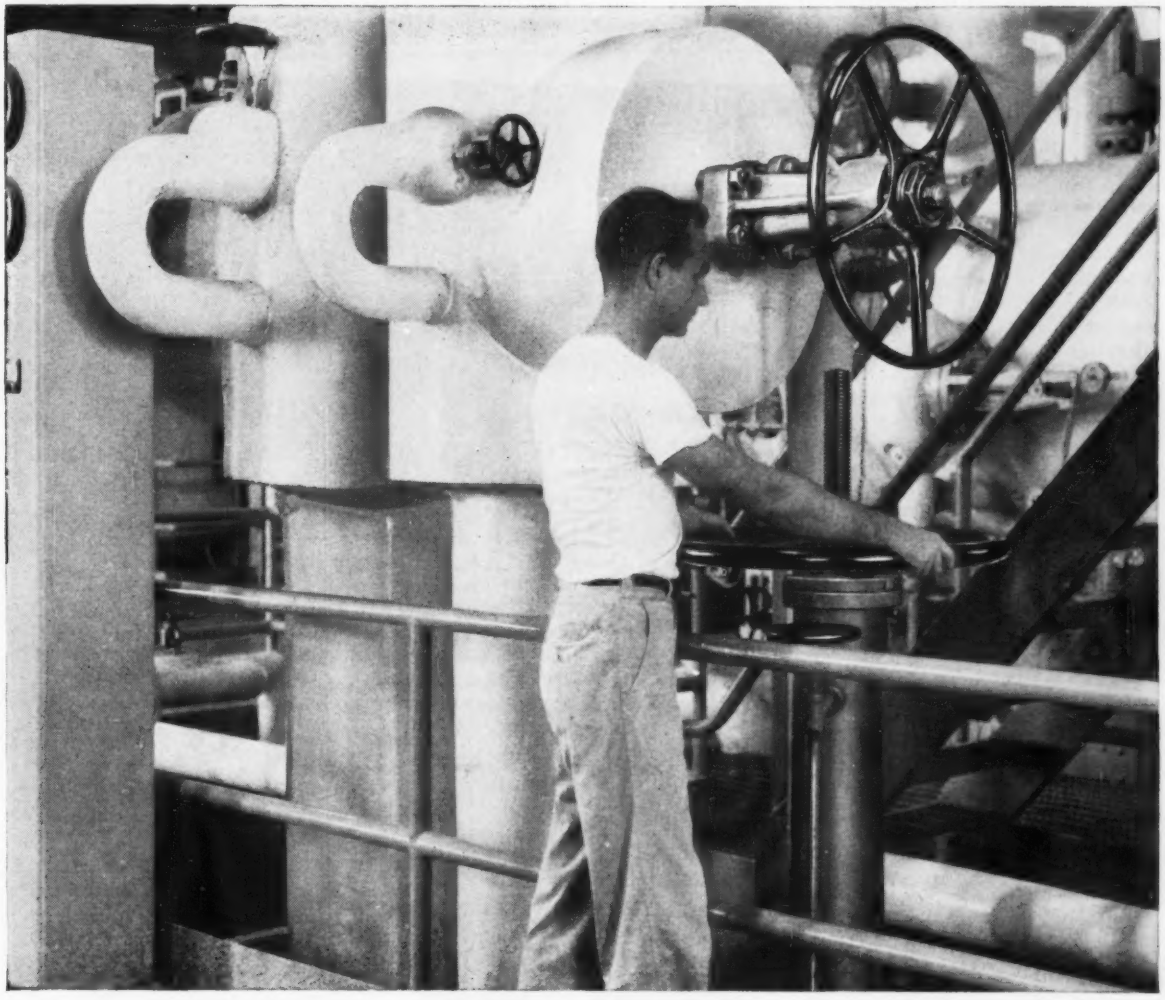
Hydraulic lubricator

1106 • Hydraulic unit is for use where lube discharge per machine cycle is relatively small. Will operate on any pressure line from 500 to 3000 psi, delivering 2 cc of oil per lubricating cycle. By resetting piston-stroke adjustment, any one of seven cycles can be obtained.

Bijur Lubricating Corp, Rochelle Park, N.J.

For details on these items use post cards on p 167. Identify request wth item number.

How Crane Steel Valves Cut Power Piping Costs



Everything's O.K. below—since 1942

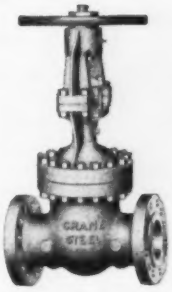
Always smooth, always positive in action—says the operator of this Crane 10-inch, 600-pound steel gate valve with extension yoke . . . and never a sign of leakage at the seats or bonnet joint.

That's the way this valve has performed for 15 years—since it was installed in a main steam cross-over line in the Nueces Bay Station of Central Power & Light in Corpus Christi. It's on working pressure of 400 psi at 830 deg. F.

The cost-in-service record of the valve is clean. It has not been touched by a mechanic except for ordinary routine servicing. Indications are it will remain in the line for a long time to come.

Unusual performance? Not for Crane steel valves. They're famous for cutting power piping costs. They're better suited for such service because of quality castings made in Crane's own foundry—with closely controlled heat-treating techniques . . . exacting machining, assembling and testing procedures that are unique with Crane.

You can be sure of low-cost steel valve performance when you specify Crane. Get all the facts from your Crane Representative or write to the address below.



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PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

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More EQUIPMENT NEWS

Begins on page 158

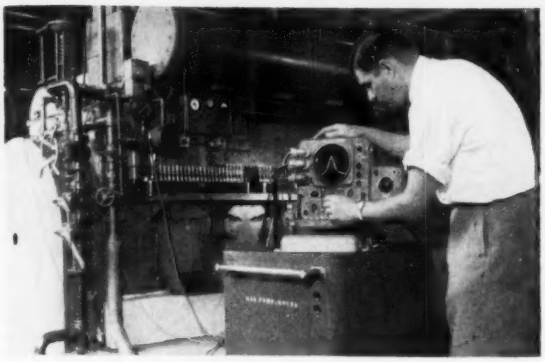
Engine analyzer cuts costs

1107 • New analyzer takes a cost-cutting look at the inner mechanical functioning of complex industrial engines, without expensive shutdowns. The hand-portable multipurpose equipment pictorially displays information formerly obtained from as many as three electronic instruments. It enables operators and maintenance men to monitor reciprocating engines—whether spark-ignited or diesel—to keep them operating at continuous peak efficiency. Analyzer also detects and pinpoints malfunctions as they develop within engines, according to manufacturer.

Analyzer is lightweight; provides three types of data: ignition, vibration and pressure. Unit employs a highly specialized oscilloscope to probe inner recesses of engines, and presents functional information on 5-in. cathode-ray screen. It can be attached while engine is running.

Electronic data is transmitted from connections to engine, through wires to control unit. Advantages are said to be simplicity of operation and easy interpretation of visual electronic patterns portrayed on a screen. Qualified operators can use the analyzer competently after a few hours' training. Connections are made without stopping engine.

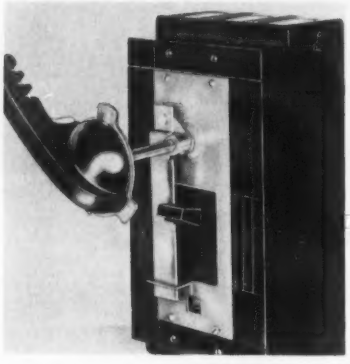
System is sensitive to one degree in detecting any ignition mistiming, manufacturer claims. A sweep is driven



across cathode-ray tube in time with engine. Resulting trace line shown on screen is responsive in vertical direction to signals from ignition, cylinder vibration and cylinder pressure. Manipulation of controls is said to present precise and complete picture of engine's operation. Connections to engine are made to flywheel, ignition primary circuit, and two to power cylinder. Request further details.

Sperry Gyroscope Co, Div Sperry Rand Corp
Great Neck, N. Y.

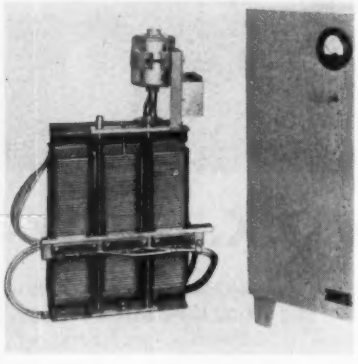
For more data on these items, use the post cards on page 167. Identify your request with item number



Circuit breaker handle

1108 • Line of extended-shaft handle operating mechanisms is provided for all circuit-breaker frame sizes E through L. New line is said to make it possible to mount breakers in cabinets or enclosures from 5⅛ in. through 17⅛ in. deep depending on breaker size and shaft length. Shafts can be cut to meet all depth requirements covered by full 10-in. shaft length. They're designed to interlock with covers for safety of operation, manufacturer states. Repositioning of shaft in socket permits upright or horizontal breaker mounting. Request details.

General Electric Company
Plainville, Conn.



Variable-voltage transformer

1109 • Single-unit variable-voltage transformers are designed for 10- to 250-kva service for line-voltage compensation, or as full-range control units with transformation ratings to 100 kva. Single or 3-phase units for operation on 240/480-v input are available in both types. Features are said to include motorized voltage-control drive, which can be remotely controlled if desired; single-transformer construction. Typical unit will operate on either 230- or 460-v input. Further information available on request to the manufacturer; use post card on p 167.

M & T Welding Products Corp
703 37th Ave, Oakland 1, Calif.

Heavy-duty rectifier

1110 • This 25-kv heavy-duty silicon-type rectifier power supply has dc output of 125 v nominal at 200 amp, or 250 v nominal at 100 amp. Unit features compact design and flexibility in application, manufacturer claims.

Designated *S125-200*, unit is 28-in. wide, 24-in. deep, 58-in. high; comes in floor standing cabinet. Ac input is 208, 230 or 460 v, 60 cycle, 3 phase. Can be connected in series or parallel, or series and parallel, to provide dc voltage and current output required over single-cubicle output.

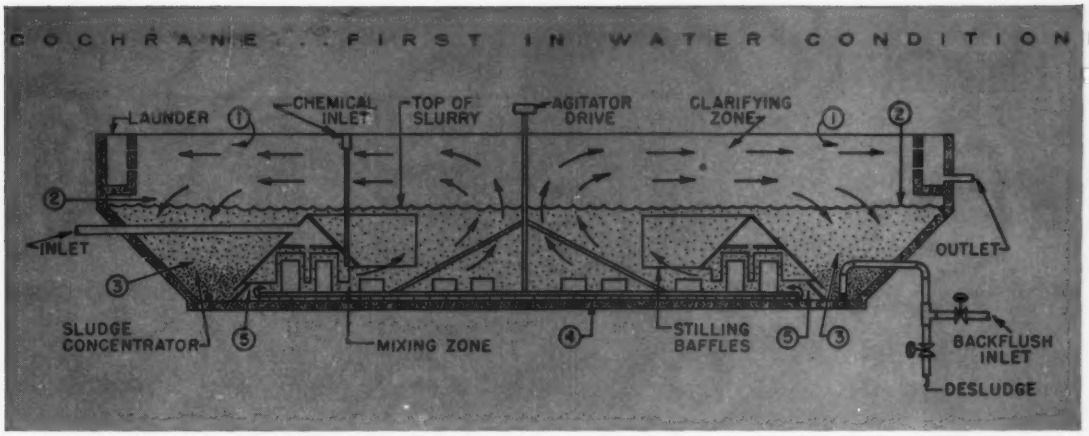
Perkin Engineering Corporation
345 Kansas St, El Segundo, Calif.

H-v motor-generator sets

1111 • Series of high-voltage units offers motors up to 200 hp, 4160 v at 1200 rpm; generators up to 300 kw, 4160 v at 1200 rpm. Alternators are available in two-bearing single-unit construction, or can be built in single or two-bearing close-coupled design for adaptation to commercial engines, manufacturer claims. Motors come only in two-bearing single-unit construction, but can be direct-connected to low-voltage alternator or other equipment.

Kato Engineering Company
1415 First Ave, Mankato, Minn.

COCHRANE . . . FIRST IN WATER CONDITIONING



A Cochrane solids contact reactor is designed to provide the ultimate in clarification

Cochrane suspended solids contact coagulating and softening clarifiers are packaged units that combine a mixing zone at the bottom with a clarifying zone above.

A bottom agitator in the mixing zone keeps old precipitates in constant suspension. Thorough mixing and contact between the old and new precipitates is thus assured. This results in a more complete reaction with a minimum in chemical requirements and retention time. In the clarifying zone the water is effectively separated from the slurry precipitates and clarified.

The Cochrane reactor design is unique in its baffle and agitator arrangement, as follows:

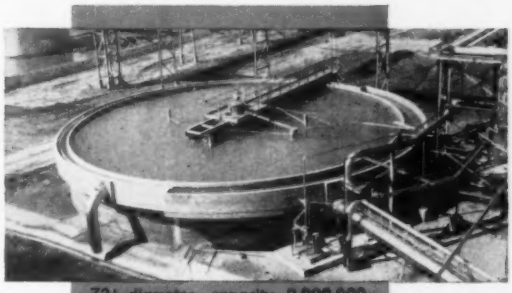
① Radial *Horizontal* Flow—*Not Upflow*. Velocity decreases from center to launder. Slurry particles separate more efficiently from horizontal flow than from upflow.

② Slurry flow is *downflow* in clarifying zone below collecting launders—*not upflow*—thus preventing carryover of turbidity into effluent.

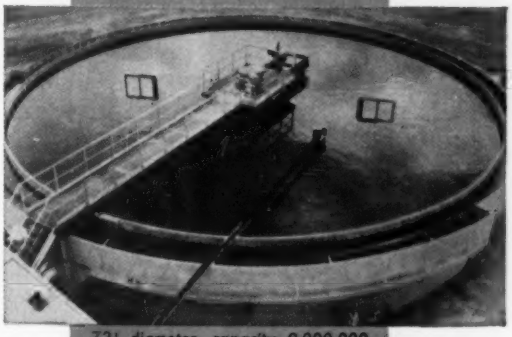
③ Sludge settles only in annular *concentrator* outside of mixing zone. Maximum concentration results because no turbulence is present. This feature saves wastage of water in desludging.

④ There is no premature loss of slurry strength in mixing zone because no sludge settles on the floor of mixing zone.

⑤ Turbulence in mixing zone assures excellent mixing. A large, full-diameter agitator causes centrifugal outward flow, against the diverting baffle in front of the outer port and turns flow inwardly towards central port.



72' diameter, capacity 9,000,000 GPD located in Georgia.



72' diameter, capacity 9,000,000 GPD located in Texas.

Two units 82' diameter—capacity 20,000,000 GPD located in Washington.

Cochrane
CORPORATION
3106 N. 17TH STREET, PHILADELPHIA 32, PENNA.
NEW YORK • PHILADELPHIA • CHICAGO

Cochrane Water Conditioning Ltd., Toronto 4, Montreal 1, Winnipeg 1, Canada.

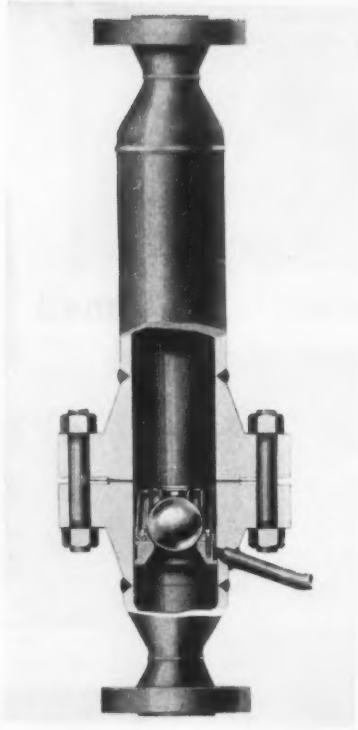
Representatives in 30 principal cities in U.S.; San Juan, Puerto Rico; Honolulu, Hawaii; Paris, France; La Spezia, Italy; Mexico City, Mexico; Havana, Cuba; Caracas, Venezuela; Santiago, Chile.

Pottstown Metal Products Div.—Custom built carbon steel and alloy products

Demineralizers • Hot Process Softeners • Hot Zeolite Softeners • Dealkalizers • Reactors • Deaerators • Continuous Blowoff Systems Condensate Return Systems • Specialties

More EQUIPMENT NEWS

Begins on page 158



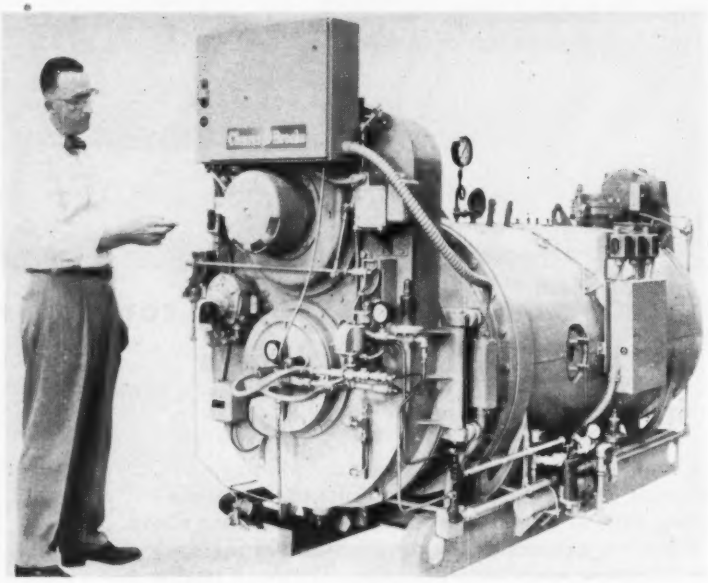
Variable-orifice desuperheater holds temperatures within 5 deg

1112 • Desuperheater for close control of reduced steam temperatures, regardless of load variations, features weighted steel ball for controlling orifice opening. Unit is said to speed intimate mixing of cooling water and steam. Vaporization is so complete that reduced steam temperature can be held constant only 20 ft downstream from desuperheater outlet, maker claims.

Unit consists of a section of steel pipe enclosing self-regulating orifice extending around full 360 deg, and a weighted ball held in concentric position. Cooling water is under control of diaphragm-operated valve responsive to temperature controller; enters orifice chamber at uniform rate of flow around 360-deg periphery.

Desuperheater uses standard temperature controller with proportional and reset features; is said to hold final temperature within 5 deg. Final temperature may be as low as 10 deg above saturation temperature. Field tests show that steam is dry a short distance downstream from outlet. Unit is available for pipeline sizes from 2 to 14 in.

Blaw-Knox Co, Copes-Vulcan Div 900 W 26th St, Erie 4, Pa.



Direct-fired oil heater reaches 600 F

1113 • Direct-fired unit is designed for heating transfer oils and other liquids. Oils may be circulated through coils, molds, jacketed vessels and other heat-exchange equipment. Heater is said to provide higher temperatures than can be economically obtained with conventional indirect-heater types.

Forced internal-circulation design of heater provides high-velocity flow of heat-transfer oil over heating surfaces. Uniform oil temperature is said to eliminate hot spots, coking or deterioration of oil. Firebrick ring in burner throat is the only refractory used.

Applications include asphalt, chemical, plastic, oil refinery industries, but unit can be used wherever heat is required. Fired with oil, gas or oil and gas, unit is "closed" type with horizontal firetube design. Unit comes in complete package with removable heater element, integral forced-draft fan and burner, all necessary operating and safety controls. Heater element has vent at top of shell. Unit is used with expansion tank and external circulating set.

Burner always returns to low-fire position for ignition, manufacturer says. Modulating thermostat senses oil temperature in heater and controls burner firing rate. Separate thermostat controls operation of internal propeller.

Cleaver-Brooks Company, 326 E Keefe Ave, Milwaukee 12, Wis.

Dust-precipitator unit is automatic

1114 • Precipitator control recovers dust by passing it through electrostatic field. Dust particles become electrically charged and attracted to metal plates placed in gas stream. Process is said to be capable of very high recovery efficiencies because it can collect small-sized particles.

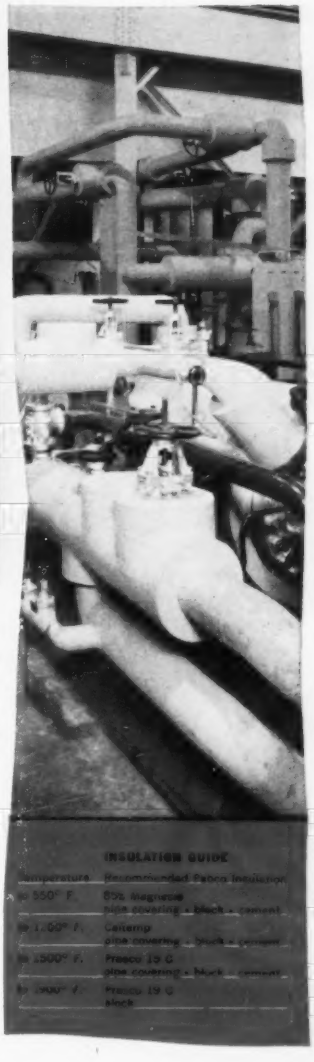
Unit requires no maintenance or parts replacement; has all-static components according to manufacturer. Comes completely sealed in electronic potting compound, is unaffected by moisture, dust, humidity.

Transistorized-circuitry is said to be one of features. Unit also has advanced sensing principle that integrates total surge current in relation to time. This provides continuous system for evaluating rate of surge current.

Western Precipitation Corp, 1000 W Ninth St, Los Angeles 54, Calif.

For more data on these items, use post cards on page 167. Identify request with item number

Complete control
of temperatures with
PABCO
PRECISION-MOLDED
CALTEMP
a Calcium Silicate
Insulation



Name your temperature. A performance-proved Pabco pipe or block insulation will maintain it at economical levels up to 1900° F. With Pabco Caltemp, 85% Magnesia, or Prasco Insulations, heat losses are reduced to an absolute minimum . . . finest performance assured. For data on technical advantages, case histories, or engineering consultation . . . write . . . or contact one of Pabco's insulation engineers.

PABCO INDUSTRIAL INSULATIONS DIVISION

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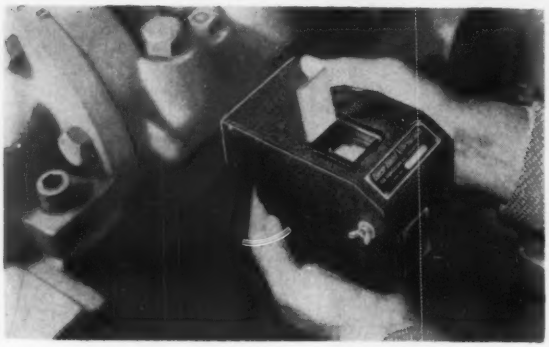
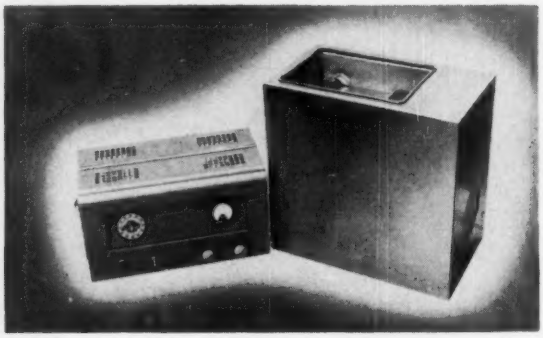
More EQUIPMENT NEWS

Begins on page 158

Five items to help solve maintenance problems





Indicator measures machinery vibration

1115 • Self-contained instrument is designed for making permanent records of machinery vibration on a continuous paper chart. Unit measures both amplitude and frequency, shows wave forms in great detail, according to manufacturer.

Salient feature is reported to be instantaneous external adjustment which selects degree of magnification desired, giving 40, 20, 10 or 5:1 ratios.

No battery or outside power source is required. Carbon-shod ball-bearing probe is provided for taking measurements directly on surface of rotating shafts. Further information available on request to the manufacturer.

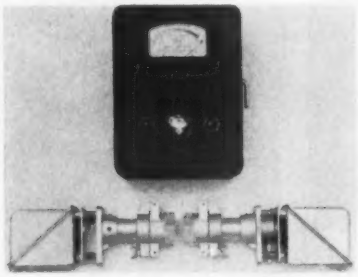
The Vibroscope Co, Route 28 (near Kingston)
P.O. Box 97, Glenford, New York

Ultrasonic cleaner is self-filtering

1116 • Ultrasonic cleaner has self-contained filtering system, operates on frequency of 40 to 44 kc. It incorporates forced-air cooling system and has cleaning-tank capacity of one gallon. Only sudless detergents or chlorinated solvents are required, manufacturer states.

Circulating pump, permanent filter element and additional tank for recirculatng fluid are said to eliminate time-consuming task of manual draining. Unit cleans by cavitation produced by ultrasonic signals transmitted in liquid; any small part, tool, or instrument not damaged by immersion in water or chlorinated solvents may be cleaned.

Vibro-Ceramics Div, Gulton Industries, Inc,
212 Durham Ave, Metuchen, New Jersey



Smoke-density recorder

1117 • Photoelectric unit is said to accurately measure, indicate and record smoke density in any duct or breeching that is pressurized. Pressure-sealing flanges seal sighting tubes on which light source and scanner are mounted. Indicator provides continuous, accurate indication of combustion efficiency, according to manufacturer.

Combustion Control Division
Electronics Corp of America
77 Broadway, Cambridge, Mass.

Colloidal-suspension spray

1118 • Spray is designed to protect outdoor storage piles of bulk material against all kinds of weather. Tough, flexible film is formed on exposure, sets in 24 hours.

Deposited film is said to resist action of wind, frost and heat; drains off rain water to eliminate channeling. Product is suitable for coating stock piles of coal, ores, coke breeze, flyash, sand and waste. It can be handled in most spraying equipment.

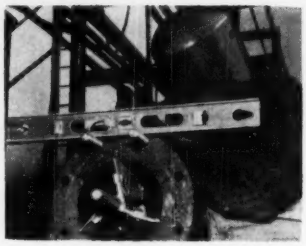
The Johnson-March Corp,
1726 Chestnut St, Philadelphia 3, Pa.

Cable splicing tape

1119 • Tape is designed for splicing and terminating either plastic or rubber cables. For connections under 2000 volts it serves as both insulation and sheath. According to manufacturer, tape, while possessing optimum electrical characteristics, is also resistant to weather, chemicals, flames and mechanical abuse. It can jacket as well as insulate and it comes in five colors for phase and circuit color coding.

The Okonite Co, Passaic, N. J.

Don't miss this item . . .



Pipe-fabrication tool ..... p 172

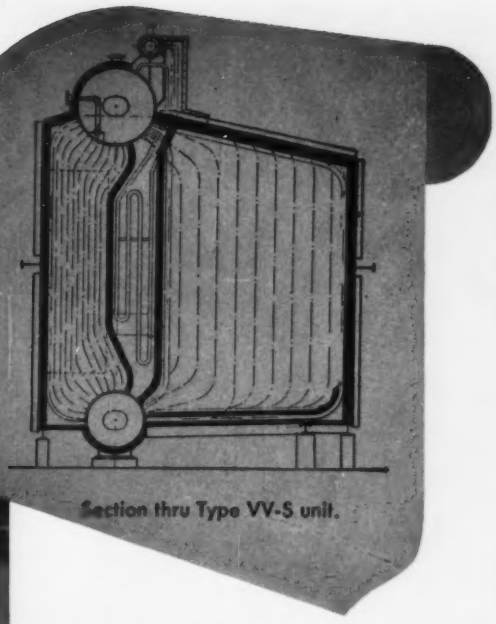
. . . or other product news appearing on following pages

Power solenoid ..... p 174
Ball bearings ..... p 176
Booster pump ..... p 178
Pumpless rectifier ..... p 182
Industrial TV camera ..... p 184
Improved steam trap ..... p 186
Cradle-mounted fan ..... p 188
Wiring raceway ..... p 194

For more data on these items, use post cards on page 167. Identify your request with item number

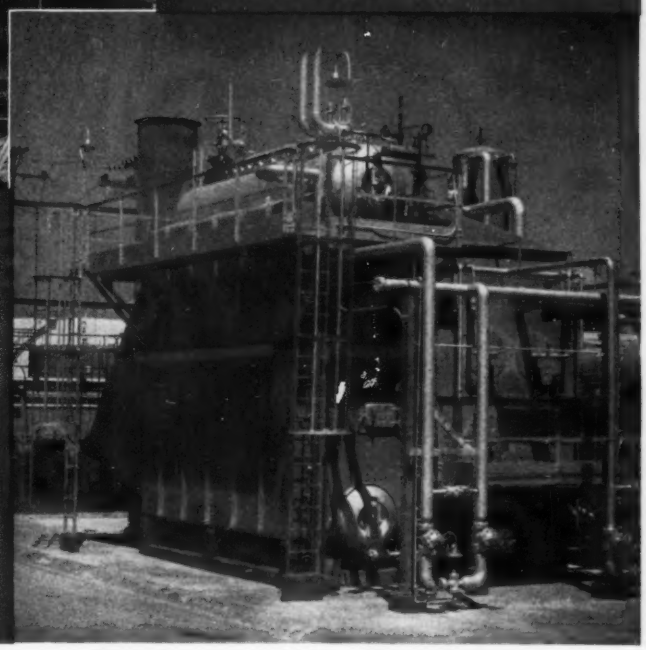
More Steam with Fewer Dollars

Vogt TYPE VV-S STEAM GENERATORS



Section thru Type VV-S unit.

Two 50,000 #/hr. units under erection at an Air Force Base.



A 65,000 #/hr. unit in a Texas Petroleum Refinery

- ★ Headerless construction for full unrestricted water circulation.
- ★ Large water storage capacity and correspondingly greater steam relieving space.
- ★ Long, narrow furnace ideal for oil or gas fuel.
- ★ Completely steel encased for "out-in-the-open" operation.
- ★ Simple slab foundation.
- ★ Capacities from 50,000 pounds to 100,000 pounds steam per hour.

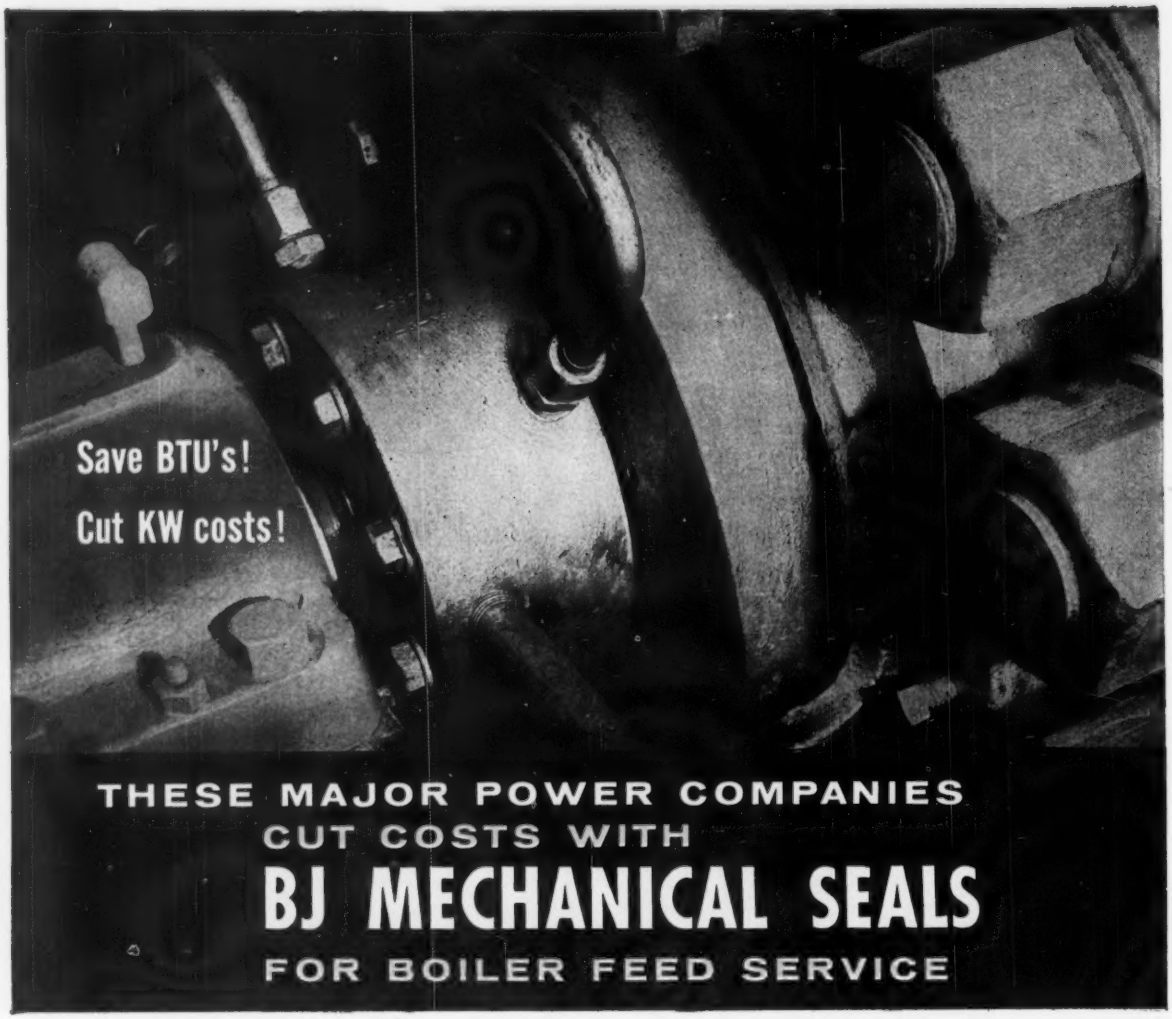
OTHER VOGT PRODUCTS

Drop Forged Steel Valves, Fittings and Flanges—
Petroleum Refinery and Chemical Plant Equipment
Heat Exchangers
Ice Making and Refrigerating Equipment

HENRY VOGT MACHINE CO.

Box 1918, Louisville 1, Kentucky

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati



THESE MAJOR POWER COMPANIES
CUT COSTS WITH
BJ MECHANICAL SEALS
FOR BOILER FEED SERVICE

- City of Pasadena (Calif.)
- Florida Power & Light
- New Orleans Public Service
- Mississippi Power Co.
- Georgia Power Co.
- Pennsylvania Power Co.
- Owensboro Public Utilities (Ky.)
- Baltimore Gas & Electric Co.
- City of Los Angeles
- Dept. of Water & Power
- Southern California Edison Co.
- Mississippi Power & Light
- City of Glendale (Calif.)
- Houston Power & Light Co.

BENEFIT FROM THIS EXPERIENCE!

Lower cost per KW . . . that's the money-saving benefit of BJ Mechanical Seals for high pressure boiler feed pumps. These efficient seals save BTU's by minimizing feed water (and heat losses) along the shaft. Additional big savings are realized by eliminating costly repacking maintenance.

Byron Jackson pioneered the first successful seals for high pressure service . . . and continues to demonstrate this leadership with more installations for a constantly growing list of major power companies. Benefit from the experience of these and other companies . . . specify BJ Mechanical Seals *and save!*

BJ
SINCE 1872

BYRON JACKSON PUMPS
INCORPORATED
A subsidiary of Borg-Warner Corporation
P. O. BOX 2017A TERMINAL ANNEX, LOS ANGELES 54, CALIF.

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METERS AND INSTRUMENTS

1 **Wind-speed system,** for direction recording on standard power lines, is described in 4-p bulletin 457. Contains suggestions on applications, details of equipment, specs. Beckman & Whitley, Inc, 860 E San Carlos Ave, San Carlos, Calif.

2 **Mechanical Btu meter** is subject of bulletin 1000. Construction and operation data; selection data on size, pressure and temperature ranges are listed. Air Conditioning Equipment Corp, 219 E 44 St, New York 17, N.Y.

3 **Temperature-conversion chart** has easy-to-read tables of Fahrenheit and Centigrade equivalents, from –40 F to 568 F. Moeller Instrument Co, 132-10 89th Ave, Richmond Hill 18, N.Y.

4 **Engine hour meter** catalog 600 has 12 pages, contains information on dc and ac meters, illustrates and describes installation, function in production and maintenance fields. Stewart-Warner Corp, 1826 Diversey Pkwy, Chicago 14, Ill.

5 **Meters** to indicate and totalize liquids, such as water, molasses, sulfuric acid, are discussed in 8-p illustrated catalog 54-766-38. Principle, construction, operation and features are explained. The Hays Corp, Michigan City, Ind.

NUCLEAR ENERGY

6 **Engineering for atomic power** is subject of 36-p color-illustrated booklet. Firm's role in war- and peace-time applications of nuclear power is described. Stone & Webster Engineering Corp, 49 Federal St, Boston, Mass.

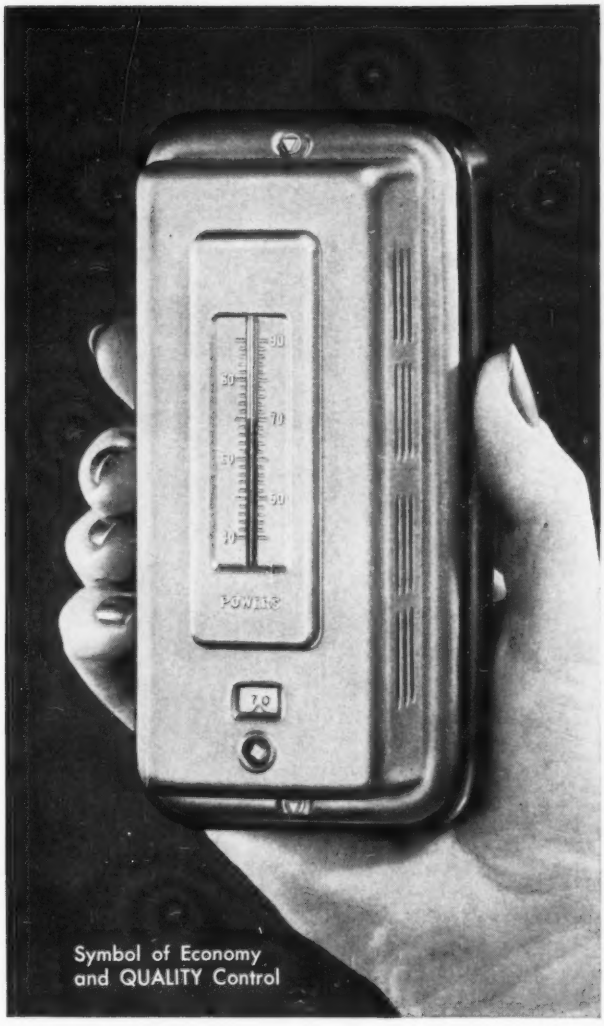
7 **Boral for shielding** of neutrons is discussed in 4-p illustrated folder. Nature of boral, its composition, uses, and shielding properties are described. Brooks & Perkins, Inc, 1950 W Fort St, Detroit 16, Mich.

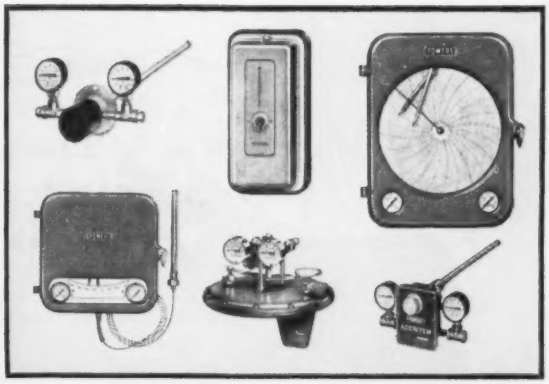
PIPING, VALVES, FITTINGS AND SPECIALITIES

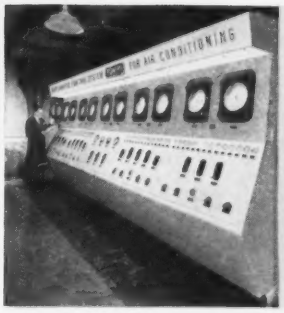
8 **Semi-steel valves** are subject of 43-p illustrated bulletin V-203, Rev 1. Has photos, drawings and description of lubricants, photos of four principal types of valves. Includes specs. Rockwell Manufacturing Co, Meter & Valve Div, 400 N Lexington Ave, Pittsburgh 8, Pa.

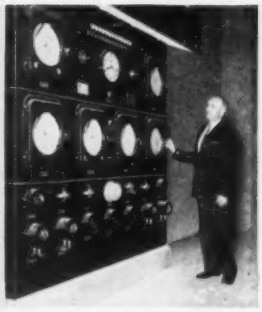
9 **Valves for automation** in steel mills are discussed in 16-p bulletin SM-1. Includes schematic drawings of piping and valve arrangements for particular applications. Golden-Anderson Valve Specialty Co, 1241 Ridge Ave, Pittsburgh 33, Pa.

10 **Steel tubing tolerances** are explained in data chart Sec. B No. 1. Both seamless and welded mechanical tubing is covered, as well as seamless and welded (*Continued on page* 226)



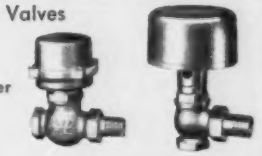


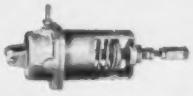




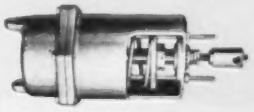
Powers PACKLESS Control Valves

Give more accurate control
Eliminate packing maintenance
Prevent leakage of steam and water





POWERSTROKE Piston Operators for Dampers, etc.
Sizes Available: 3", 4", 6".



POWERS Control Systems eliminate OVER-heated rooms, reduce fuel bills and increase production

Lowest Maintenance and Repair Cost and 15 to 40 years of dependable control are often reported by users

The superior year after year performance of Powers QUALITY control has been time tested and proved dependable in thousands of buildings since 1891.

When you have a temperature or humidity control problem check it over with an experienced Powers engineer. His suggestions may be helpful in getting the best control for your requirements.

Selecting the right type of control pays big dividends in greater comfort, fuel economy and more efficient operation of heating, ventilating and air conditioning systems. To make sure you get the best control . . . specify and install Powers.

FLOWRITE Diaphragm Control Valve

For further information contact our nearest office.

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65 Years of Automatic Temperature and Humidity Control

(c77)

George Edwards

hears a nifty way to hog-tie a rumor

► EVERY NOW AND THEN an idea comes down the pike that's so simple, but so effective, that we wonder why somebody didn't think of it long ago. Last week I heard of one that could go quite a way in helping to lick one problem that bothers a lot of plant people.

The Crouse-Hinds Company, an electrical parts manufacturer in Syracuse, N. Y., has made a standing offer to any employee who is worried by anything he hears via the plant "grapevine." A letter to management asking for the truth of the matter will bring a point-blank answer. Further, management sends a copy of its reply to supervisors in the departments involved so they can spread the facts among other guys who may be upset.

We all know that a rumor can be a vicious thing and is as tough to pin down as a moonbeam. Usually no one seems to know exactly who started it. Like Topsy, it appears to have "just growed."

Everyone remembers some of the rumors that went the rounds during World War II. Some were more or less innocent, others were definitely aimed by the source at sabotaging our war effort. Calculated to stir fear and uneasiness as only a rumor can, they got to the point where the FBI took an interest in ferreting out the guy who started them.

It's true that some rumors deal with things that would be nice to have happen, but in a lot of these cases it's just a buildup for a big letdown. Sometimes, but not often enough, a rumor can boomerang on the guy who started it.

Remember the story of the old sourdough back in the gold-rush days? He started a rumor "just for fun" about a strike a hundred miles away. Most of the folks in the settlement sold everything they had to get a grubstake, started out after the gold.

The old boy sat back and had a good laugh when they left. By and by, however, he began to hear tales from strangers passing through town. Unknown to our joker, they'd met some of the eager prospectors and the story of the new strike had lost nothing in the telling.

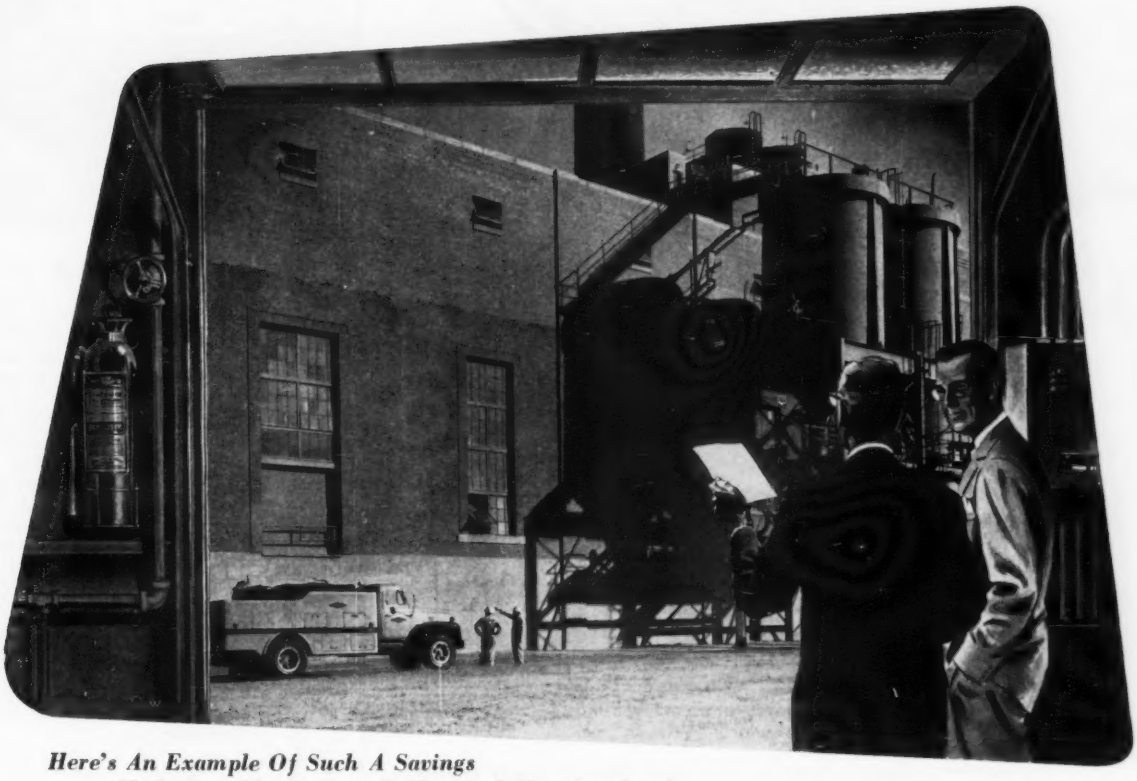
Finally, he couldn't stand it any longer. Maybe there really was a strike. He drew every nickel he had out of the bank, bought pack mules and gear and went after the will-o'-the-wisp he'd created.

Our workaday world is full of scuttlebutt and we let most of it roll off our backs because it doesn't matter much if it's true or not. But if there's a rumor around our plant that hints at a company policy change, an upcoming layoff, a guy we don't like being made our boss, or any one of a number of things that might make it rough for us—it can put us through a mental wringer.

Aside from the bubbleheaded practical joker, most people pass rumors along for two basic reasons: either they get a temporary feeling of being a big-shot, or it's a matter of misery wanting company. But regardless of how or why it's passed around, nothing can pull the rug from under plant morale as fast as a disturbing rumor.

For my money, the Crouse-Hinds people have given their employees a club that can knock a rumor in the head before it gets off the ground.

how much could you add to your profit-- by saving $50,000 per boiler cleaning?



Here's An Example Of Such A Savings Made Possible By Dowell Chemical Cleaning Service

Dowell recently chemically cleaned a 1,000,000 lb. per hour steam generator for one of its customers. Total outage time was 48 hours. This saved the company an estimated five to seven days down-time, as compared to mechanical cleaning methods.

Considering replacement power for a boiler of this capacity costs between $7,000 and $15,000 per day, it's easy to see a $50,000 savings. And, it's just as easy to project a $250,000 to $500,000 annual savings for a plant with five to ten such boilers.

This particular case history concerns a power company with a forward-looking operations manager. But, Dowell has other startling performance data to show you — from your own industry. That's because chemical cleaning is so versatile. Dowell engineers are experts in removing scale and sludge from process systems, tanks and piping. They apply solvents in various ways— such as filling, jetting, cascading. Dowell furnishes all the necessary chemicals, trained personnel, pumping and control equipment.

For specific information on how chemical cleaning can help you to greater profits, call the Dowell office near you. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

25 years forward

have Dowell clean it chemically

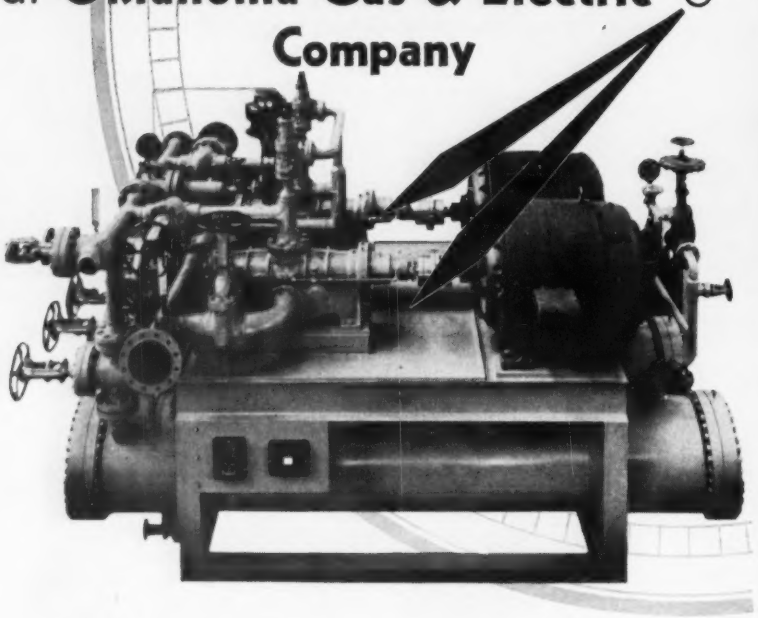
DOWELL

A SUBSIDIARY OF THE DOW CHEMICAL COMPANY

WARREN SCREW PUMPS

work 'round-the-clock

at Oklahoma Gas & Electric Company



Pumping heavy fuel oil

to the boilers at the RIVERBANK STATION of the Oklahoma Gas & Electric Company is a full-time job for these two Warren Screw Pumps (#5¼ Long Body)

For many months they have been providing 24-hour-a-day service at full efficiency for this important installation:

The heavy fuel is fired in a radiant type boiler with nominal steam capacity of 1,200,000 pounds per hour. The steam-driven turbo generator has a nominal capacity of 170,000 KW, and the turbine operates at 1800 PSIG and 1000°F. at the throttle valve, with reheat to 1000°F.

Operating temperature of the #6 Bunker "C" fuel oil is 100° to 225°F.; capacity is 225 GPM; discharge pressure is 675 PSIG; and using 150 HP—1150 RPM electric motors.

Warren Pumps are most important to the uninterrupted functioning of this installation. Like so many other power companies throughout the country, Oklahoma Gas & Electric Company is completely "sold" on Warren for long, dependable pumping service.

WRITE FOR BULLETINS S205 AND S206

WARREN — CENTRIFUGAL · SCREW · RECIPROCATING · ROTEX

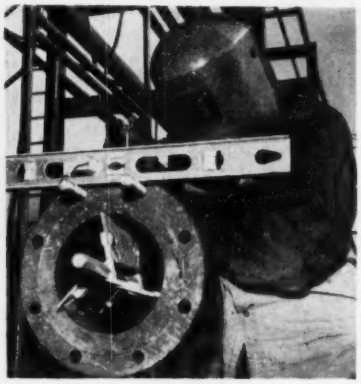
WARREN PUMPS, INC.

WARREN, MASSACHUSETTS

P-38

More EQUIPMENT NEWS

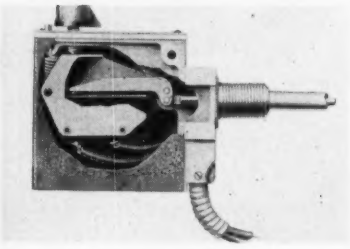
Begins on page 158



Pipe-fabrication tool

1131 • Unit is designed for use in fabrication of pipe utilizing weld-neck flanges or stub-ends. Tool is inserted into pipe and flange or stub-end placed on projecting end. Few turns of mandrel brings blades into contact with pipe and fitting ID's. The 3-blade design assures positive lineup of internal surfaces, according to manufacturer. Four units available accommodate pipe sizes from 3 to 20 in. Blades are interchangeable for 6- to 20-in. sizes. Tool can also be used as a centering device for grinding bevel on alloy tubing.

Line-O-Tool Company
1927 Bank of the Southwest
Houston 2, Texas



Immersion-type thermostat

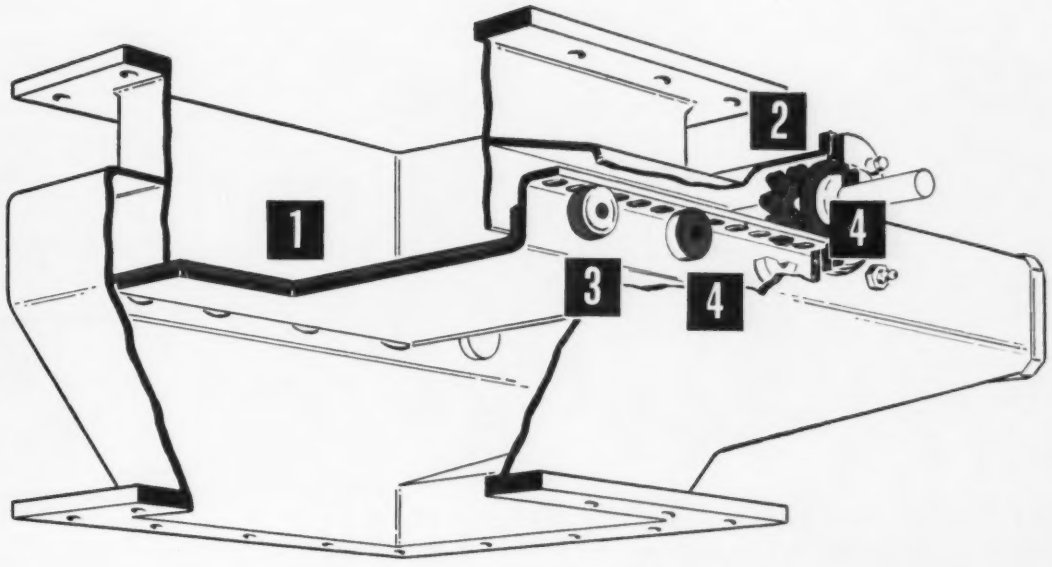
1128 • Unit is for use where there is a sensitivity of temperature change down to a fraction of a degree. Thermal element is composed of two metallic members; highly expansive metal tube with low-expansion steel rod on the inside. Differential expansion of two metals operates snap-acting switch. Switch rating is 15 amp, 125 v.

Alloy Bellows, Inc, 18125 Roseland Rd
Cleveland 12, Ohio

For more details on these items, use post cards p 167. Identify your request with item number.

Power-transmission belt

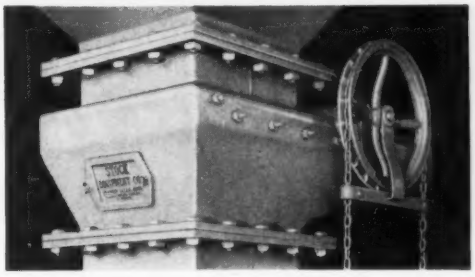
1138 • Belting is a combination of polymer and chrome-tanned leather. Polymer is tensile member, leather is friction surface. Advantages of belting are said



The inside story

ON THE S·E·CO COAL VALVE...

STAINLESS STEEL



Wherever you find coal you find corrosion—or the possibility of corrosion. And wherever you find corrosion you find valves that stick, are hard to operate and that will soon need replacement.

Stainless steel resists corrosion — makes valves that are easy to operate and that have a much longer life. That's why Stock Equipment Company has made stainless steel a *standard material* for certain vital parts of the S-E-Co. Coal Valve.

Take the deep U-shaped gate, for instance. The stainless steel liner (1) on top combats corrosion. This not only means longer life, but by preventing pitting it reduces friction when closing against a head of coal.

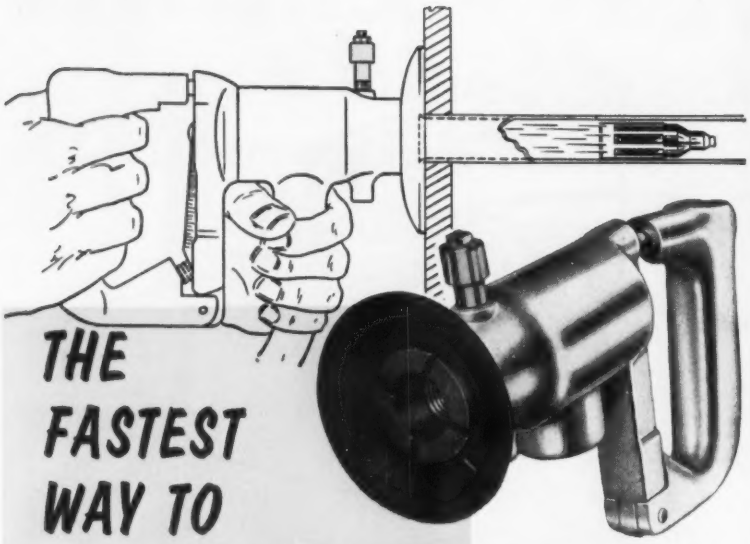
Multi-faced pinions (2) located above the self cleaning racks are also of stainless steel. By withstanding corrosion the thin pinion sections maintain their strength and are thin enough to make racks and pinions truly self-cleaning.

In addition, stainless steel is used for the shells of the gate-supporting rollers (3) and for the grease seal retainer rings on roller and shaft bearings. (4).

For dependable, efficient valve operation, get S-E-Co. Coal Valves which feature stainless steel as a standard material. If you have a particularly severe problem of corrosion, Stock Equipment Company can help insure normal operation and long life by making the valve body itself entirely of stainless steel.

STOCK Equipment Company

745-P HANNA BLDG. • CLEVELAND 15, OHIO



THE FASTEST WAY TO CLEAN CONDENSER TUBES

John Crane®

Super-Jet®

CONDENSER TUBE CLEANER

"John Crane" Super-Jet tube cleaning equipment offers the simplest yet most effective method for maintaining top heat transfer efficiency in steam condensers for these 5 reasons:

1. **EFFICIENT**—handy gun-and-slug method removes slime or scale in record time.
2. **VERSATILE**—interchangeable nozzles permit water or air operation. Slugs are available in types and sizes to insure positive cleaning under practically all conditions.
3. **SPEEDY**—one man can load an entire bank with cleaning slugs and shoot them through in rapid succession.
4. **ECONOMICAL**—slugs can be used over and over again. Rugged gun is built for long, hard service.
5. **EASY OPERATION**—simple-to-operate gun weighs only 2¼ lbs., does not require a skilled worker and can be used for lengthy periods without fatigue.

Request Bulletin P-324. Ask about special 10-day free trial offer.

Crane Packing Co., 3430 Oakton Street, Morton Grove, Illinois (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

Interchangeable Nozzles

Air or water operation—effective pressures 50-200 psi.

Slugs For All Services

Spool-type for normal slime removal, bullet-shaped for heavy or thick slime deposits and scraper-type for scale and mineral deposits. Latter two slugs have "jet action" holes that air or water-flush away deposits as removed.

CRANE PACKING COMPANY

More EQUIPMENT NEWS

Begins on page 158

to be: slip- or stretch-proof operation; speeds up to 24,000 fpm; up to 6000 hp; smooth constant speed at low tensions; operation at ratios up to 20:1. Polymer is said to have tensile strength of 28,500 psi. Request full details from manufacture.

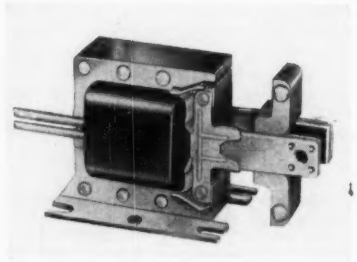
Extremultus, Inc, 405 Lexington Ave, New York 17, N.Y.

Adhesive for *Teflon*

1136 • Material will bind *Teflon* to *Teflon*, to metal or other materials. Adhesive is of pressure-sensitive type; tests are said to indicate peel strength of over 1000 grams per in. or a direct pull of 12 to 15 psi for *Teflon* to *Teflon* or stainless steel. It's reported to have good acid and alkali resistance, excellent electrical properties and can be applied by brushing, dipping, spraying. Request full details.

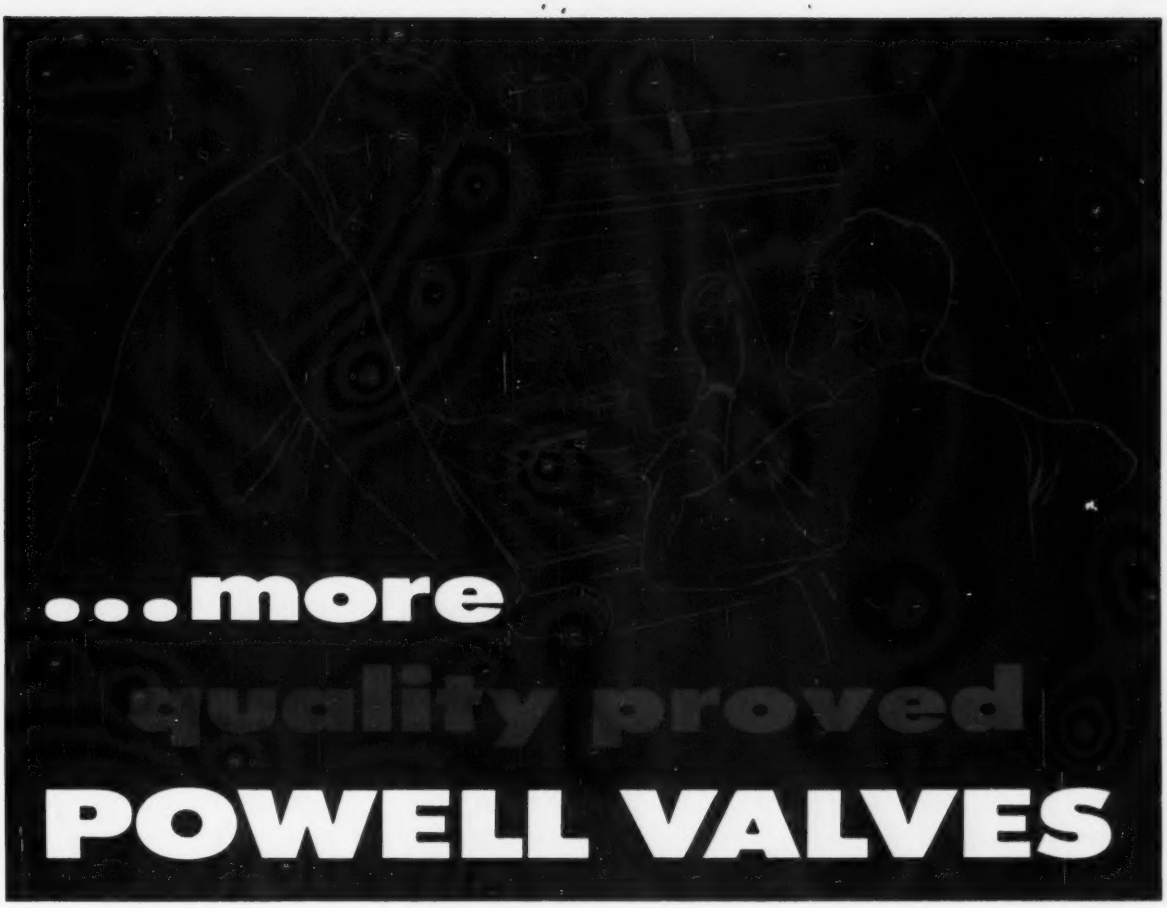
Flexrock Co, Packing Div 3677 Filbert St, Philadelphia I, Pa.

For more details on these items, use post cards p 167. Identify your request with item number.



Power solenoid

1130 • Claimed feature of unit is a coil winding that's completely encapsulated in *Permaseal* thermo-setting epoxy. Unit is said to prohibit penetration by water, extreme humidity, oils, salt air,



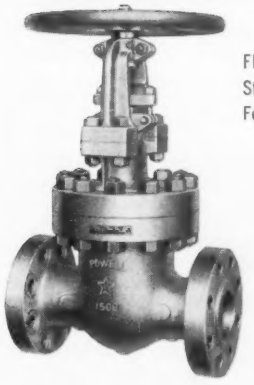


FIG. 1303 SS—1500-Pound Stainless Steel Gate Valve for handling Boiler Feed Water Treating Compound.

FIG. 3061 WE—300-Pound Steel Swing Check Valve.

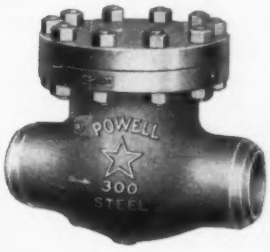
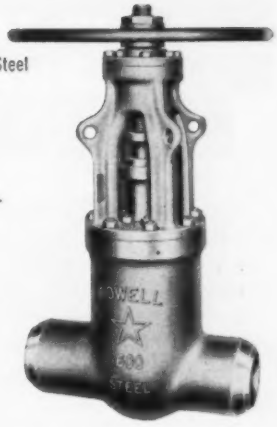


FIG. 1314 A—1500-Pound Integral Bonnet Steel "Y" Valve.

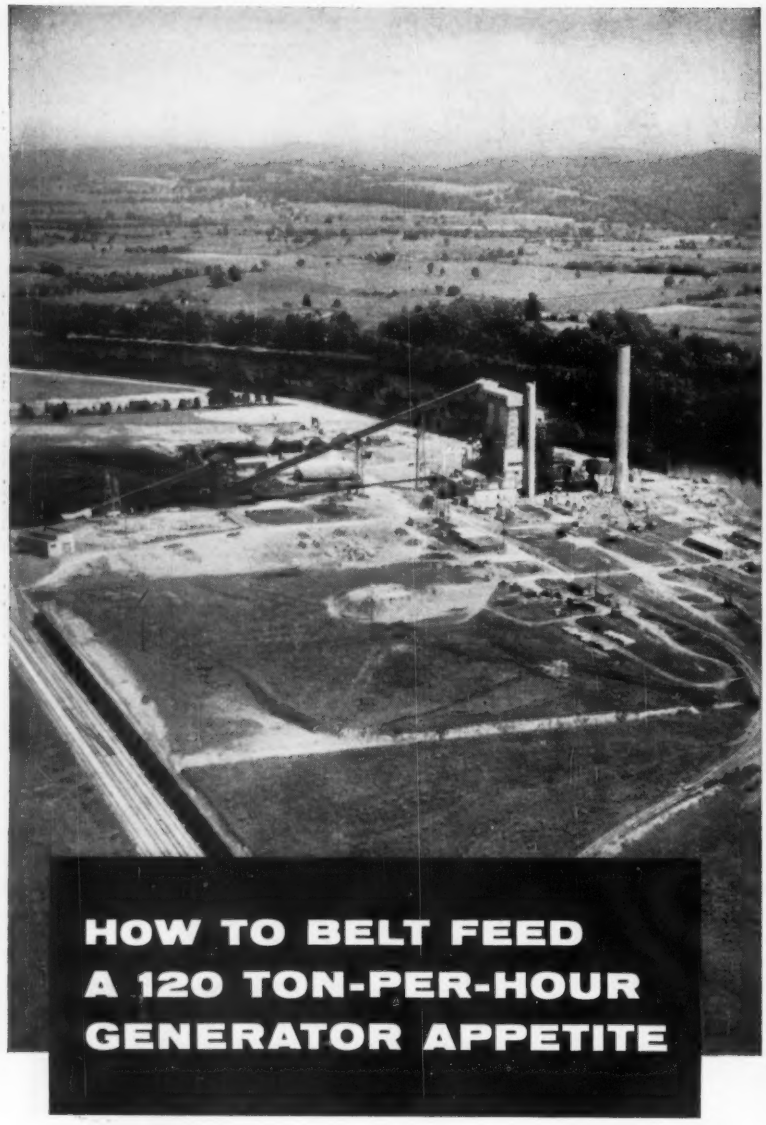
FIG. 16003 WE—600-Pound Steel Pressure Seal Gate Valve.



Designed for long life, designed for dependable service

Consult your Powell Valve distributor for all the facts about quality proved bronze, iron, steel and corrosion-resistant valves. No matter what the flow control problem, a Powell Valve can solve it . . . *better*.

THE WM. POWELL COMPANY, CINCINNATI 22, OHIO . . . 111th YEAR



Pennsylvania Power & Light Company's two units at Martins Creek "eat up" 120 tons of coal per hour in generating 160,000 kw each. In coping with this huge appetite problem, PP&L uses a completely automatic coal handling system developed by Hewitt-Robins.

The 600 ton-per-hour capacity system includes an H-R Heavy Duty Car Shakeout, an H-R Gyrex® Scalping Screen, four belt conveyors, two belt feeders and operating machinery. Working through Ebasco Services, Incorporated, Hewitt-Robins engineered, manufactured and installed the entire coal handling system. To find out how H-R products and services can help you, consult your classified telephone directory for the nearest H-R representative, or contact Hewitt-Robins, Stamford, Conn.

HR HEWITT-ROBINS

CONVEYOR BELTING AND IDLERS...POWER TRANSMISSION DRIVES
INDUSTRIAL HOSE...VIBRATING CONVEYORS, SCREENS & SHAKEOUTS

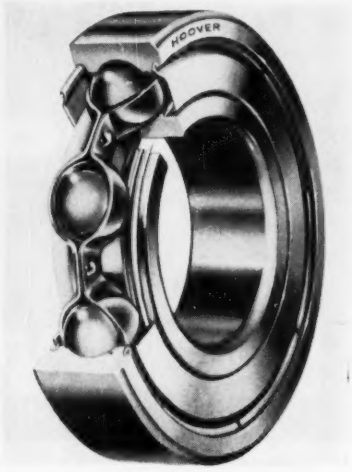
More EQUIPMENT NEWS

Begins on page 158

acid and alkaline solutions, ether, alcohol, hydraulics and other fluids. Applications include refrigeration and air conditioning. High dielectric strength, resistance to abrasion and thermal or mechanical shock are features which add to solenoid's service life, manufacturer states. Unit is available for intermittent or continuous-duty operation. Request further information.

Guardian Electric Manufacturing Co
1621 W Walnut St, Chicago 12, Ill.

For more details on these items, use post cards p 167. Identify your request with item number.

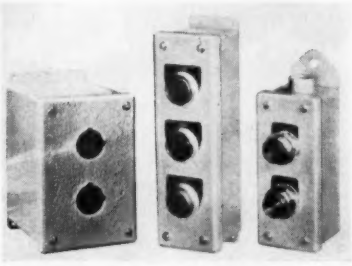


Permanent-lube ball bearings

1141 • Units have lubrication sealed in to last their lifetime. *Teflon* seals provide contact between inner raceway and metal shields, prevent dirt from reaching working surfaces, thus extending length of bearing service life.

Lubricated-for-life ball bearings are for use in sustained high-speed operations, or in sealed units. Available in light and medium series.

Hoover Ball & Bearing Co
Lennox at Hoover, Ann Arbor, Mich.



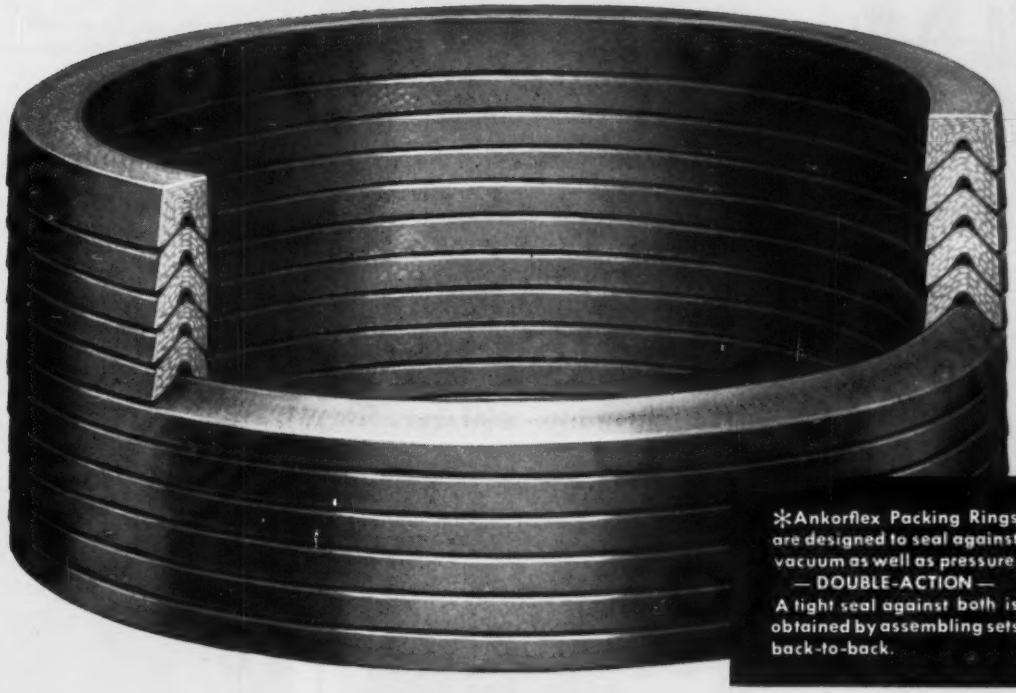
Pushbutton enclosures

1142 • Oil-tight units made of welded steel are designed to receive any regular make of oil-tight pushbutton units.

The extra-deep enclosure (No. 1 in photo) is 4¾ in. deep, provides greater

This time . . . pack it for keeps . . . with

ANKORFLEX DOUBLE-ACTION* DOUBLE-ACTION PACKING!



*Ankorflex Packing Rings are designed to seal against vacuum as well as pressure.
— DOUBLE-ACTION —
A tight seal against both is obtained by assembling sets back-to-back.

SEALS AT THE SLIGHTEST FINGER PRESSURE!

Here is a superior industrial packing that insures a positive seal against steam, oil, water, hydraulic fluids and hot gases—*under all extremes of vacuum or pressure!*

Special "lip" construction, sensitive to the finger touch, provides highest packing efficiency with minimum frictional drag on the rod or ram.

Ankorflex Packing Rings are available in a variety of sizes for rams of one-inch diameter to 30 inches or more, and for deep or shallow stuffing boxes, with or without provision for gland adjustment.

See the experienced Anchor Representative in your city, who will be pleased to help you with your hydraulic or pneumatic packing problems. Or, contact the Anchor General Office in Philadelphia.

Increases in pressure cause an outward expansion of the "lip", increasing the sealing action.

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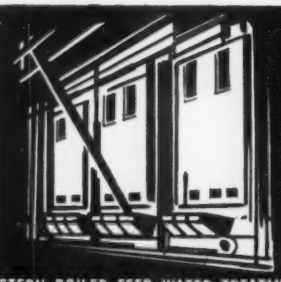
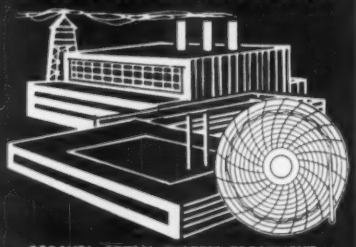
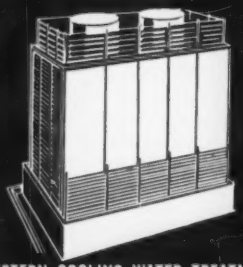


WESTERN BOILER FEED WATER TREATMENT



CORAVOL STEAM SYSTEM TREATMENT



WESTERN COOLING WATER TREATMENT and ALGAECIDE

ANTI-FOAMS for BOILER WATER
WESTO POTABLE WATER TREATMENT
WESTERN SWEET WATER TREATMENT
WESTO BRINE TREATMENT
WESTERN FUEL OIL SLUDGE DISPERSANT
WESTERN SOOT REMOVER
WESTERN LIGHTNING SCALE REMOVERS
WESTERN ALUMINA No. 45 COAGULANT

SOLVE your PROBLEMS of

WATER STEAM and FUEL TREATMENT

Economically! Dependably! with

WESTERN CHEMICAL

To preserve your equipment and to keep it operating continuously, efficiently, and economically, is the purpose and end result of the use of specialized Western formulas and the individual technical service that goes with them.

Whether your problem is scale or pitting in your boilers—corrosion in your steam and condensate lines—scale, corrosion or algae growth in your cooling water system—sludge in your fuel oil supply—soot in combustion areas—or any other problem related to your use of water, steam or fuel—it can be solved by Western Chemical Company. That is our business and it has been for over 65 years.

From this one source you can get the benefit of long experience, combined with the most advanced technical methods, to save you the cost of repairs, replacements, and service interruptions.

RELY ON WESTERN.

ONE Source for Complete Technical Information

In the series of Western Technical Bulletins you will find the story behind your particular problem—its causes and prevention. Without obligation, take advantage of this opportunity which can lead to definite savings in both costs and headaches. Write today for complete information.

Send **TODAY** for **FREE** Literature

WESTERN CHEMICAL CO., 713 Washington St., Kansas City 5, Mo.
I am particularly interested in the chemical treatment of:

_____

Please send me complete information.

NAME _____

FIRM _____

ADDRESS _____

CITY _____ **ZONE** ___ **STATE** _____

More EQUIPMENT NEWS

Begins on page 158

space needed for wiring stacked or tandem oil-tight pushbutton units. Ten standard sizes accommodate from one to 25 buttons.

The slim enclosure (No. 2 in photo) is 2½ in. square, can be mounted vertically or horizontally. Standard sizes hold from one to ten pushbutton units.

The pendent enclosure (No. 3 in photo) is 2½ in. square and has a conduit hub. This type is suited for controlling overhead cranes. Standard sizes accommodate from one to eight pushbutton units.

Hoffman Engineering Corp
Anoka, Minn.

12-in. booster pump

1133 • High-capacity oil-diffusion booster unit with 12-in. inlet diameter produces pumping speeds between 5200 and 6000 cfm at pressures from 0.8 to 5 microns of mercury.

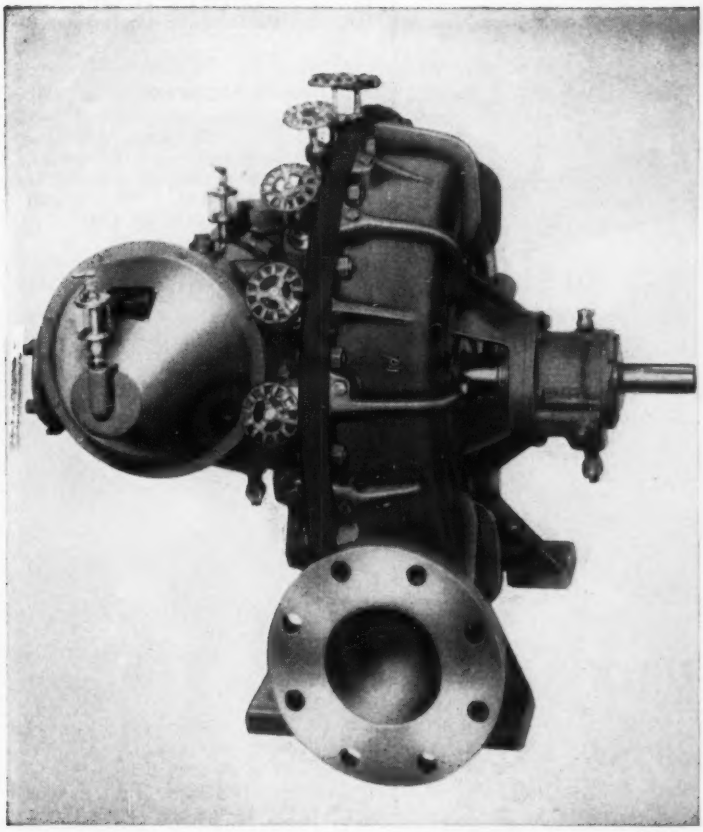
Forepressure tolerance of 900 microns makes booster useful for installation in series with high-vacuum diffusion pumps where maximum gas-handling capacity is required in the submicron range, including melting and heat-treating furnaces and large vacuum metallizing systems, manufacturer states. Details from manufacturer.

NRC Equipment Corp
160 Charlemont St
Newton Highlands 61, Mass.

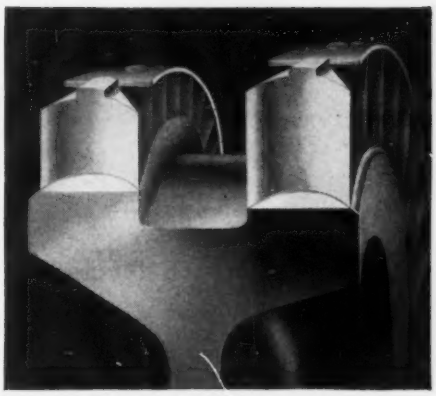
For more details on these items, use post cards p 167. Identify your request with item number.

Cooling-tower packing

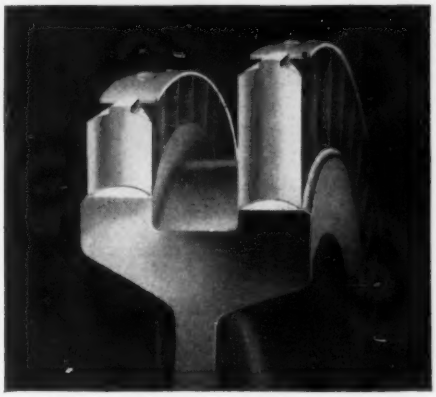
1126 • Packing features resistance to biological growth and deterioration in water. Made of high-impact polystyrene or linear polythyleme, packing comes in 3x3-ft or 2x4-ft grids made up of vertical ribs about 2 in. apart. It is said to have



This is the reliable Coppus Turbine furnished with either type of wheel



Wide bucket "L" type wheel



Regular type wheel

Top performance in all COPPUS TURBINES

Both the regular type wheel or wide bucket "L" type wheel give you Coppus proven high quality and low maintenance cost. The "L" type wheel is the new development for use where low water rate is essential.

Coppus "Blue Ribbon Turbines" earned their fine reputation right on the job. Users vouch for their top quality performance and their low maintenance cost.

In the words of the supervisor of a large chemical company: "Coppus turbines require so little maintenance that a person would starve to death, if he depended on it for a living."

Proven features of *all* Coppus Turbines:

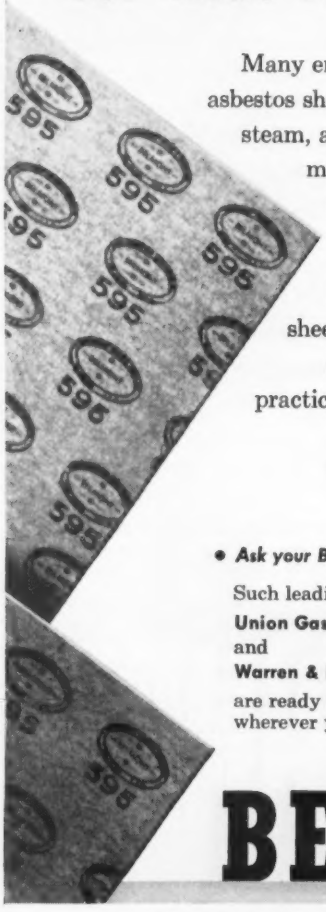
- Turbines rated close to your hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, ***make turbine dollars go farther.*** Send for Bulletin 135 on Coppus Turbines.

COPPUS ENGINEERING CORPORATION
171 Park Avenue, Worcester **2**, Mass.
Sales offices in THOMAS' REGISTER

COPPUS "BLUE RIBBON" TURBINES

VERSATILE sheet packing for wide range of service



Many engineers call Belmont's compressed asbestos sheet packings for dry and saturated steam, air, gas, oil, solvents, ammonia and most chemicals—"the handiest sheet packings in the plant."

Various compositions and special binders, all thicknesses 1/64" to 3/16", sheet sizes to 150" x 150", or supplied as cut gaskets to specifications, for practically all maintenance requirements.

The Belmont Packing and Rubber Co.
Butler & Sepviva Sts., Phila. 37, Pa.

• ***Ask your Belmont Distributor for his recommendations.***

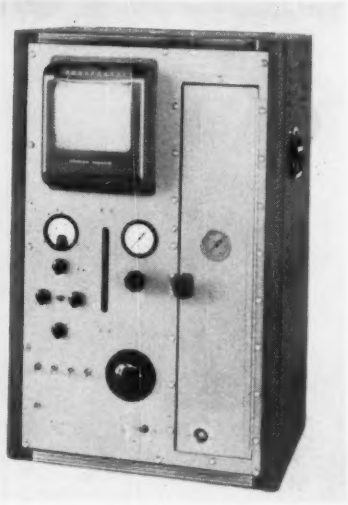
Such leading Packing Distributors as:
Union Gasket & Packing Co., in Denver, Colorado
and
Warren & Bailey in Los Angeles, California
are ready to serve you promptly and helpfully, wherever you are.

BELMONT

More EQUIPMENT NEWS

Begins on page 158

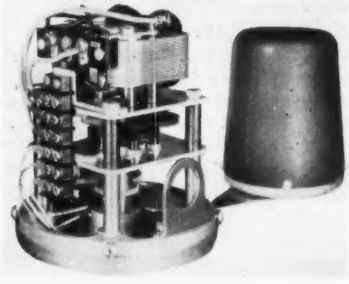
a very high performance coefficient and a unit pressured drop comparable to wood-film type packing. Product is light weight with relatively high percentage of void space. Request further information.
The Fluor Corp, Ltd, 2500 S Atlantic Blvd, Los Angeles 22, Calif.



Chromatography analyzer

1124 • High-flexibility gas chromatograph is said to be basic instrument with optional accessories for specialized applications. Unit has built-in circuitry for filament-element of ultra-sensitive thermistor-element detectors. Vertical oven has space for coiled or U-bend columns. Temperature range is from ambient to 425 F.
Loe Engineering Co
Box 234, La Canada, California

For more details on these items, use post cards p 167. Identify your request with item number.

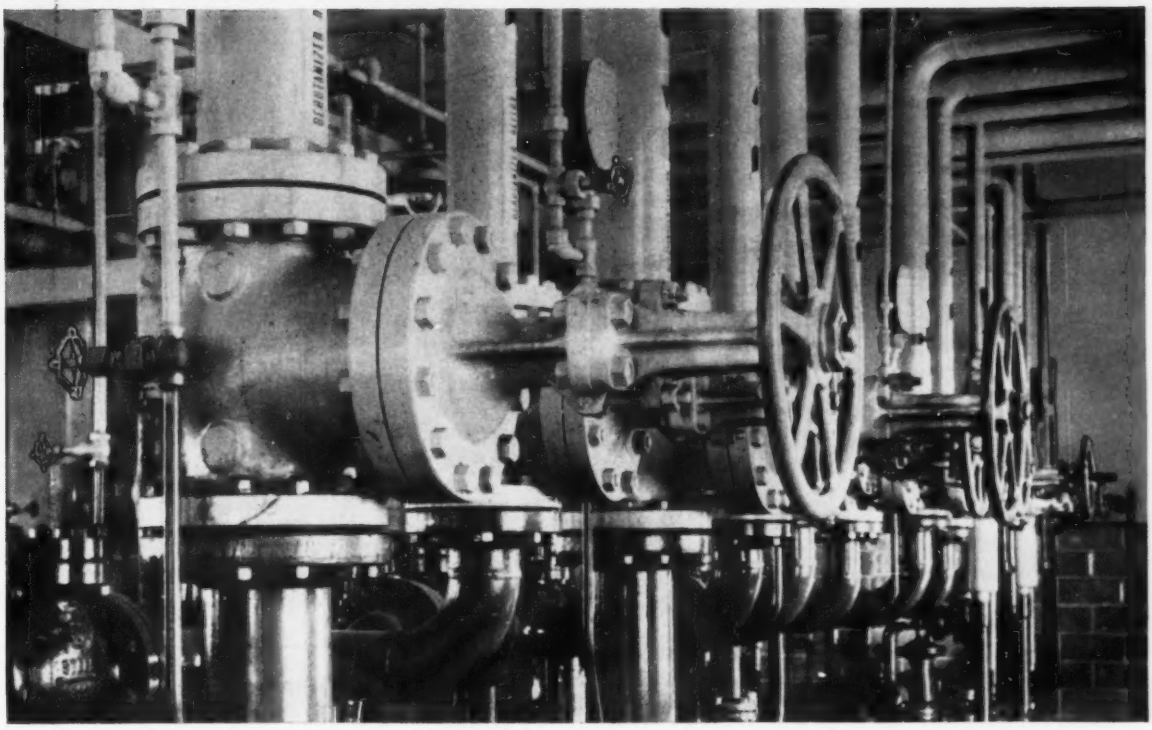


Shaft-mounted gearmotor

1143 • Unit provides remote electrical control with indication of position, speed, valve setting, etc. obtained on a calibrated meter. Includes a built-in potentiometer that provides remote indication and control for valves, variable speed drives, gates, jacks and variable displacement pumps. The potentiometer may also serve in bridge circuits of automatic control systems. Con-

Don't Hedge on Quality When You Buy Steel Valves...

Maintenance costs can gobble up your savings in a few months!



LUNKENHEIMER QUALITY is no longer a luxury—it's your vitally needed insurance against today's sky-high maintenance expense. Labor rates are going still higher . . . "downtime" costs are multiplying . . . repair charges are rocketing up—with no relief in sight. Today, it pays to buy the *best valves you can get,* with no hedging on quality. Your purchase of Lunkenheimer Steel Valves is an investment that pays worthwhile dividends in maintenance savings . . . year after trouble-free year. The Lunkenheimer Company, Box 360, Annex Station, Cincinnati 14, Ohio.

The cost of a LUNKENHEIMER VALVE
Gets smaller...and smaller...and smaller...
with each passing year of dependable service

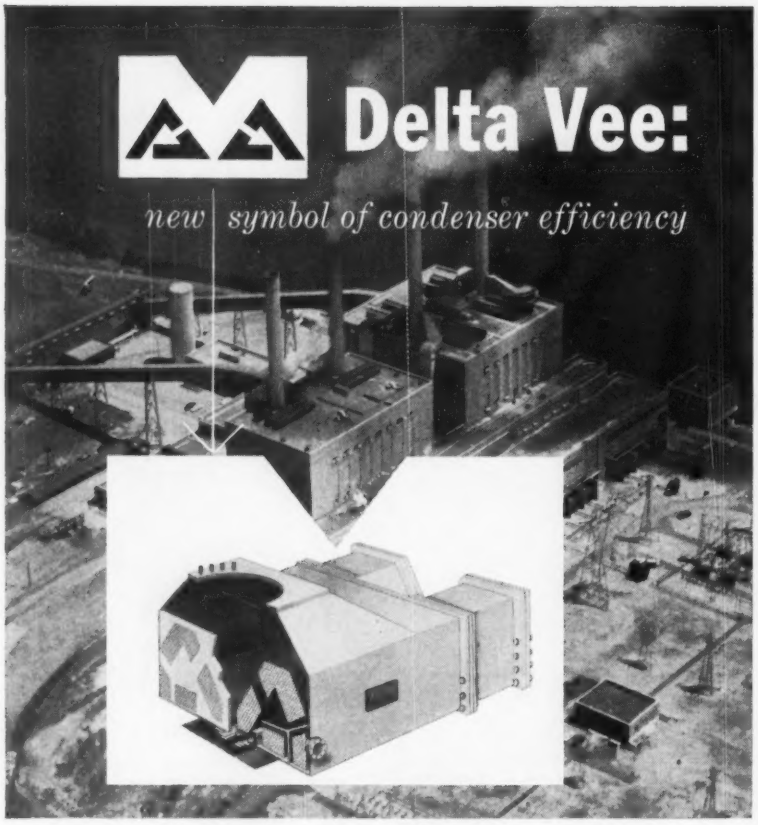
A check on the cost of maintaining your cast steel valves will prove this point.

STEEL • BRONZE • IRON • PVC

L-1086-2

LUNKENHEIMER QUALITY

LUNKENHEIMER®
THE ONE *Great* NAME IN VALVES



ONLY SWECO SURFACE CONDENSERS OFFER DELTA VEE DESIGN

The water circuit uses V-type water boxes and reversing chamber. Roughly 60% of the water feeds the main banks of tubes; the remainder feeds the secondary condensing sections and air-cooling sections at the sides of the water box.

The condensing circuit is in two delta-shaped tube bundles, one group in each half of the condenser. The two groups are mirror images. The main condensing banks are formed by the arms of the deltas; the base forms the secondary condensing sections and the air-cooling sections.

SWECO Surface Condensers are designed for prime mover service with large steam turbines. Available in sizes from 3,500 square feet and up, SWECO Surface Condensers offer these design advantages:

maximum de-aeration—from large contact-tube areas, positive steam-vented hot well.

even distribution of steam—generous admission area to tube bank reduces water and vapor pressure drop.

increased efficiency of heat transfer—condensate forming on upper tubes flows over minimum number of lower tubes, eliminating water blanketing.

compact installation—low headroom minimizes excavation or structure necessary to set condenser below turbine.

accessible for servicing—end covers are removable, divided water box permits one side of condenser to operate while the other is being cleaned or serviced. (Similar construction is available in non-divided water box design.)

SWECO enters the surface condenser and ejector field with more than forty years experience in the production of pressure vessels and heat exchangers...in thermal and mechanical design...and with complete manufacturing facilities.

Construction, operation and features of SWECO Surface Condensers are described and illustrated in brochure M-3-393. Write for your copy today.

SWECO

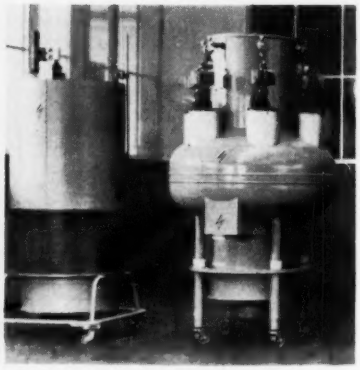
Southwestern Engineering Company
4800 Santa Fe Avenue, Los Angeles 58, California
Engineers and Constructors...Manufacturers

More EQUIPMENT NEWS

Begins on page 158

trol may be by dial control, by pushbutton, or it may be automatic from limit switches, controllers or proportioning devices.

The Jordan Co, Inc
3235 West Hampton Ave
Milwaukee 9, Wis.

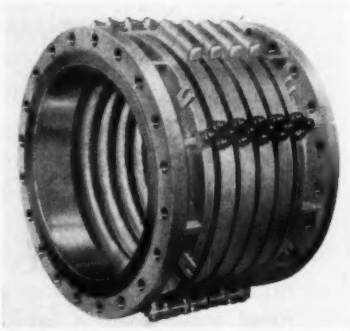


Pumpless rectifier

1140 • Pumpless steel tank unit, with mercury vapor and rare-gas filling, is said to be particularly adaptable to requirements of electro-chemical industry, dc networks, electric traction. Advantages cited include non-aging electrode inlets with steel-glass-ceramic welds; long duration of vacuum; instantaneous starting at 100% load. Rare-gas filling prevents build-up of over-voltages on anodes, eliminating danger of arc back according to manufacturer.

Secheron Works Co, 250 Park Ave
New York 17, N.Y.

For more details on these items, use post cards p 167. Identify your request with item number.



Corrugated expansion joints

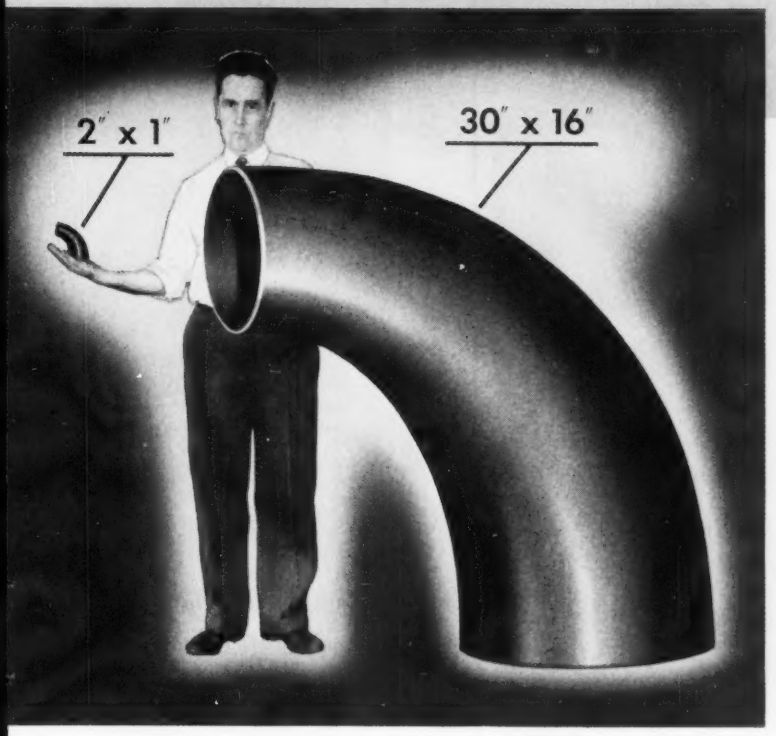
1144 • Corrugations in joints share movement of power and process piping systems equally.

These units are said to be suited to all-weather outdoor piping systems and for indoor systems operating on frequent on-and-off cycles to protect piping and related equipment against damage from temperature change.

Units are made from stainless steel in sizes from 3 to 72 in. dia and for tra-

NOW . . . IN STOCK . . . NOT SPECIALS

MIDWEST REDUCING ELBOWS UP TO 30″



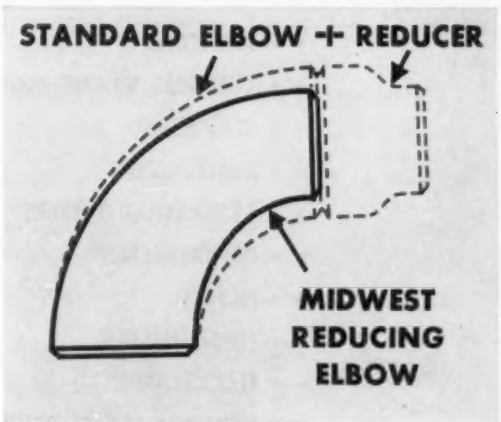
Your demand for Midwest Reducing Elbows has dictated our decision to make them STOCK items in all pipe sizes to 30″ OD and all reductions to one-half the nominal pipe size. We now have a modest stock of practically all sizes in standard and extra heavy weight, and this stock is being added to as rapidly as possible.

Midwest Reducing Elbows are also made as "specials" in heavy wall and/or any weldable alloy. The fact that our raw material is plate instead of tubing greatly increases our range of wall thicknesses and types of materials . . . it also improves the delivery.

Note the significant advantages of Midwest Reducing Elbows listed below. For further information, get in touch with the nearest Midwest Distributor or write us for Catalog 54.

✓ CHECK THESE ADVANTAGES OF MIDWEST REDUCING ELBOWS

- ✓ Save more than ⅓ of the welding required by standard elbows and reducers.
- ✓ Reduce turbulance and pressure drop because of gradual taper.
- ✓ Fit into smaller space than straight elbows and reducers.
- ✓ Greater piping design opportunities . . . easily adaptable for making special reducing fittings such as "bull-head" tees and back-outlet elbows.
- ✓ Improve appearance of piping.
- ✓ Available from stock in sizes to 30″ OD. (Heavy walls and alloys on special order.)



MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second St., St. Louis 4, Mo.

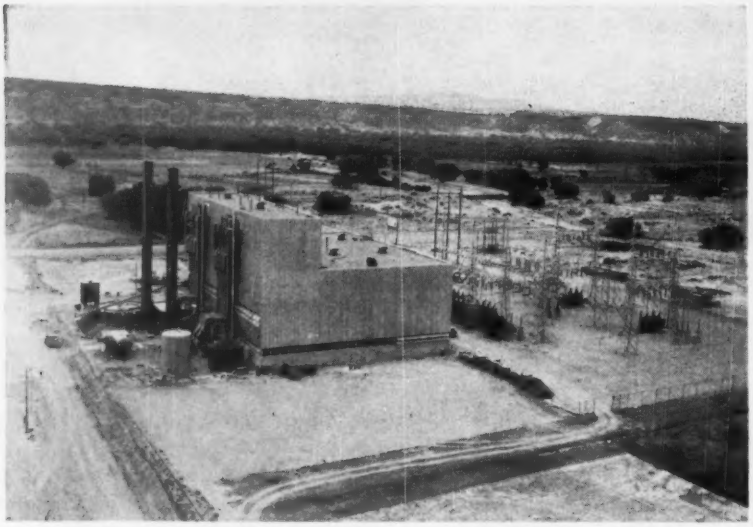
PLANTS: ST. LOUIS, CLIFTON, N. J. and LOS ANGELES

SALES OFFICES:

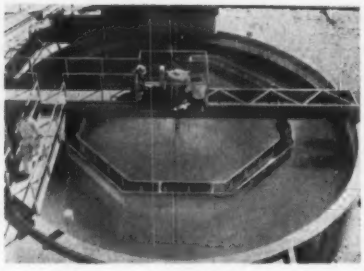
ASHEVILLE (BOX 446, SKYLAND, N.C.)
BOSTON 27—426 FIRST ST.
CHICAGO 3—79 WEST MONROE ST.
CLEVELAND 14—616 ST. CLAIR AVE.
HOUSTON 2—1213 CAPITOL AVE.
LOS ANGELES 33—520 ANDERSON ST.
MIAMI 34—2103 LE JEUNE RD.
NEW YORK 7—50 CHURCH ST.
ONEIDA, N.Y.—282 NORTH MAIN ST.
PITTSBURGH 19—437 GRANT ST.
SAN FRANCISCO 11—420 MARKET ST.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

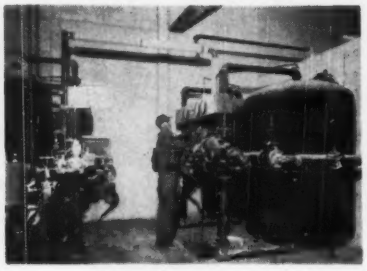
7662



A LARGE POWER PLANT IN NEW MEXICO
(Water treatment units below)



Contraflo tank for softening with lime and alum. Conveyor for chemicals, left



Twin zeolite softeners can be controlled easily by only one operator.

WATER TREATMENT

- AERATORS
- CHEMICAL MIXING EQUIPMENT
- CLARIFIERS
- DEALKALIZERS
- DEAERATING HEATERS
- DEMINERALIZERS
- FILTERS
- FLASH MIXERS
- FLOCCULATORS
- IRON-MANGANESE REMOVAL
- WATER SOFTENERS
  (Lime Soda-Zeolite)

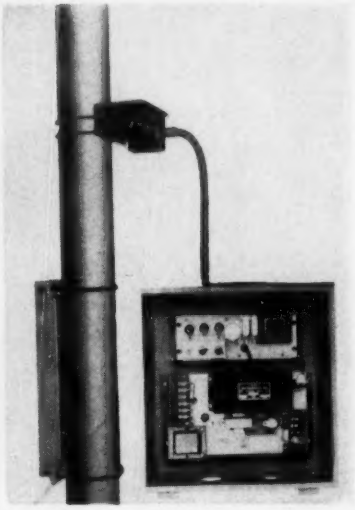
GENERAL FILTER COMPANY
AMES, IOWA

More EQUIPMENT NEWS

Begins on page 158

verses up to 7½ in. in a single or 15 in. in a double unit. Standard units are designed for 150 and 300 psi working pressures, but can be made for higher pressures on special request.

Zallea Bros, 815 Locust St
Wilmington 99, Del.



Level-indicating equipment

1125 • Equipment permits recording and level-control of most process materials, over range from 6 to 48 in. Recording and controlling devices can be located up to 2000 ft from point of measurement. Unit is said to feature maximum safety factor, immunity to elements and corrosive action. Details from manufacturer.

Instruments, Inc,
Box 556, Tulsa, Okla.

For more details on these items, use post cards p 167. Identify your request with item number.

Self-contained TV camera

1120 • Single-unit closed-circuit camera has associated remote-control accessories. Vidicon unit weighs 12 lb, is completely self-contained within camera housing. Comes with camera tube and 3-lens manually operated turret for quick variation of lens focal length.

Remote control kits allow remote opera-

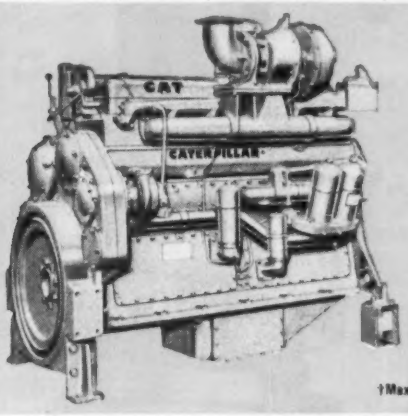
CATERPILLAR ANNOUNCES

Another heavy-duty engine in the world's most advanced line of Diesels

D397	D375	D342	D339	D337	D326	D318 (SERIES G)	D315 (SERIES G)	D318	D315	D311
650 HP†	430 HP†	225 HP†	140 HP†	310 HP†	200 HP†	175 HP†	115 HP†	137 HP†	91 HP†	65 HP†

New D353 — 390 HP†

Length 75⅜"
Width 47½"
Height 69¼"



†Maximum output capacity

The engine that delivered outstanding performance in the famous D9 Tractor is now available as the D353 Industrial Engine, Electric Set and Marine Engine. Like all modern CAT* Diesels, the D353 incorporates in its design the advanced features developed by Caterpillar in a quarter century of diesel leadership. Its four-cycle design delivers the long, effective power stroke that puts power to more efficient use than other types of engines. Its fuel system requires no adjustment. There are no cylinder ports to clean. And it operates on a wide range of fuels including premium diesel fuels as well as low-cost No. 2 furnace oil *without fouling*. All these and other features add up to performance that no unit in its power class can match.

With the addition of the D353 to the Caterpillar Engine line, you now have an even wider choice than ever for your requirements. Engines are available up to 650 HP (maximum output capacity) and electric sets up to 350 KW (continuous duty). Either as original or replacement power, there's one among hundreds of different arrangements that exactly meets your needs. Leading manufacturers of machinery can supply these models in the equipment they build.

For complete information about the new D353 and other Cat Diesels, see your Caterpillar Dealer. Let him show you how diesel leadership based on a quarter century of experience can engineer the modern heavy-duty diesels of tomorrow.

The new Cat D353 Engine is a six-cylinder, four-cycle, valve-in-head turbocharged diesel. It is available as an electric set rated at 200 KW (continuous duty) and as a marine engine. A full line of matched attachments is also available – items such as air, electric and gasoline starting systems; clutches; bases; controls and governors; cooling systems and mufflers.

CERTIFIED POWER FOR CAT DIESEL ENGINES

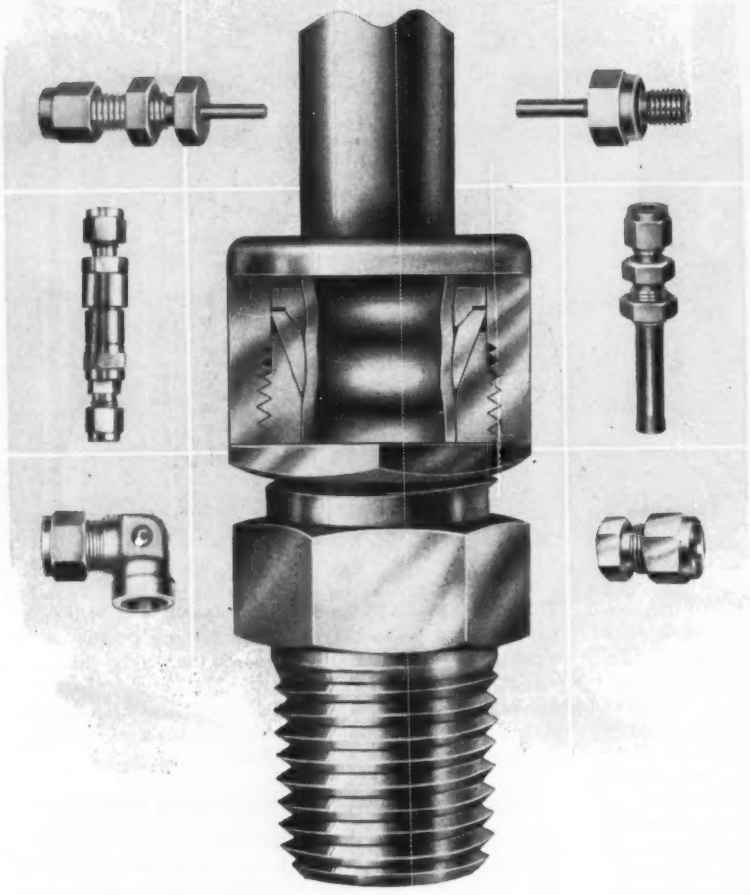
Through the years, Caterpillar Engines have earned a reputation for *honestly rated power*. Now Caterpillar backs this reputation with a *notarized certificate* covering the horsepower capabilities of each engine. You have a right to demand *certified power* when you invest in an engine. You get it when you buy from your Caterpillar Dealer!

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

HIGH vacuum seal



Swagelok®

TUBE FITTINGS

For information on the extensive line of Swagelok High Vacuum Tube Fittings and the name of your Swagelok Specialist, write Dept. **E-8.**

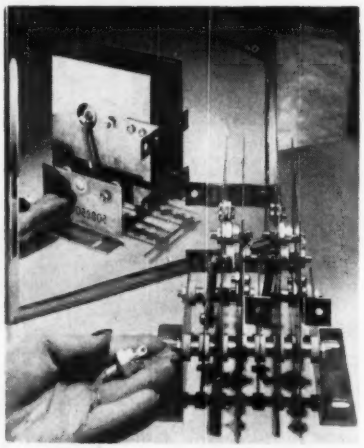
CRAWFORD FITTING COMPANY
884 East 140th Street • Cleveland 10, Ohio

More EQUIPMENT NEWS

Begins on page 158

tion of lens iris, focus and turret. Intercom provision is built in. Unit housing is 5-in. wide, 7½-in. high, 12-in. long.

General Precision Laboratory, Inc
63 Bedford Rd, Pleasantville, N. Y.



Silicon rectifiers

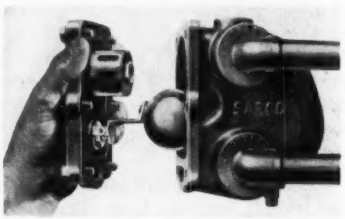
1145 • Units are hermetically sealed silicon rectifying cells providing dc currents up to 35 amps and 22 amps, halfwave, respectively, with a maximum peak inverse voltage up to 600 volts.

Forward voltage drop of cell 302 will not exceed 0.9 volts at a forward current of 10 amps in ambient temperatures of 25 to 35 C. Reverse leakage of cell is a maximum 20 milliamperes at rated peak inverse volts and maximum temperature. Maximum operating junction temperature is 190 C, manufacturer states.

For cell 303, forward voltage drop will not exceed 1.2 volts at a forward current of 10 amps in an ambient temperature of 25 to 35 C. Reverse leakage is a maximum 10 milliamperes at rated peak inverse volts and maximum temperature. Maximum operating junction temperature is 190 C.

Westinghouse Electric Corp
Box 2099, Pittsburgh, Pa.

For more details on these items, use post cards p 167. Identify your request with item number.



Improved steam trap

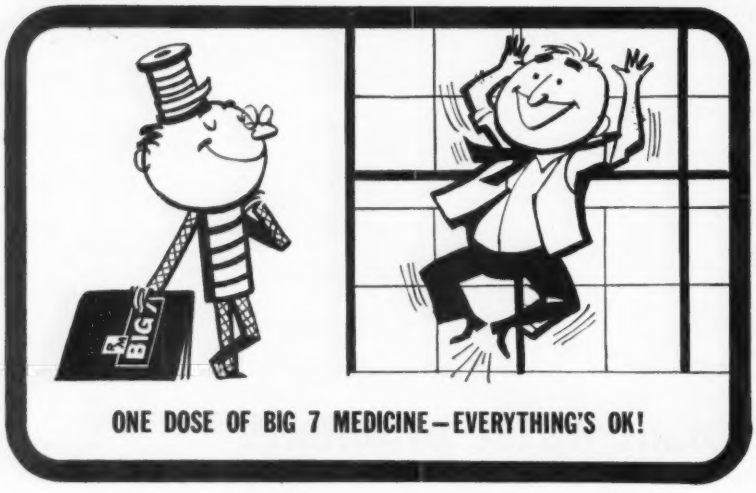
1139 • Float-thermostatic steam trap is said to have simplified construction to facilitate inspection, maintenance, installation. Operating element is one unit, can

what's your plant water problem?

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

BETZ LABORATORIES INC., Philadelphia 24, Pa.

PETE PACKING FINDS HELLSAPOPPIN' IN THE STOCKROOM



ONE DOSE OF BIG 7 MEDICINE—EVERYTHING'S OK!

There's nothing like R/M's Big 7 Packings for bringing order out of chaos in the stockroom. This basic line of just 7 packing types has greatly simplified the whole packing problem. For one thing, you will probably only need 3 or 4 out of the 7. With these, you will get peak performance in all of your applications. This means that you can lower inventories, simplify ordering, cut investment costs. In addition, you can greatly reduce the chances of error through wrong selection. That's a lot of advantages for you.

Call in your R/M distributor and discuss your packing problems with him. He knows his business and will be glad to show you how R/M Big 7 Packings can make your job easier.

R/M's BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS

R/M packings for maintenance purposes are sold only through authorized R/M distributors

R/M

BIG 7 PACKINGS

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, PASSAIC, N.J.

MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Passaic, N.J.; Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

More EQUIPMENT NEWS

Begins on page 158

be removed without disturbing inlet and outlet connection to semi-steel trap body. Unit is suitable for 125-psi steam pressure.

Operating elements consist of stainless-steel valve mechanism, copper float, bronze thermostatic air vent. Valve is said to provide condensate seal and prevent loss of steam. It discharges condensate at steam temperature continuously, without shock.

Sarco Co, Inc, 350 Fifth Ave
New York 1, N.Y.

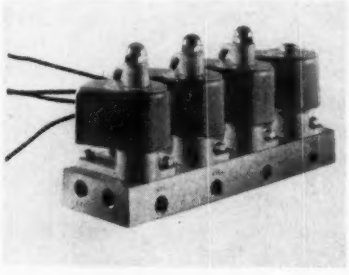
For more details on these items, use post cards p 167. Identify your request with item number.

Cradle-mounted fans

1146 • Direct-connected units are designed for product cooling, man cooling, drying, recirculation, elimination of air stratification and similar applications where movement of air will facilitate job performance.

Unit is available in five sizes from 16 through 36 in. and has air delivery ratings to 18,700 cu ft per min.

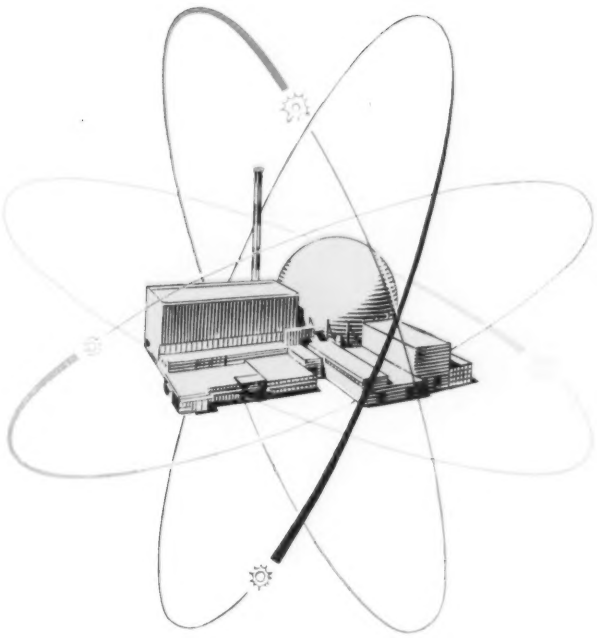
Robbins & Myers, Inc
Springfield, Ohio



Solenoid valves

1147 • Line of 2- and 3-way valves is designed for manifold mounting. According to manufacturer, any combination of 2- and 3-way valves may be used when operated from a common pressure and return line. Valve solenoids may be controlled individually or in any combination, depending upon service requirements.

Valves may be mounted in any position without affecting operation. They are suitable for handling air, gas, water, light oil,



LADISH

IS THE FIRST NAME IN

Controlled Quality

PIPE FITTINGS FOR

NUCLEAR AND CONVENTIONAL

POWER INSTALLATIONS

18" alloy steel elbows with 3.9" wall for extremely high pressure-temperature service.

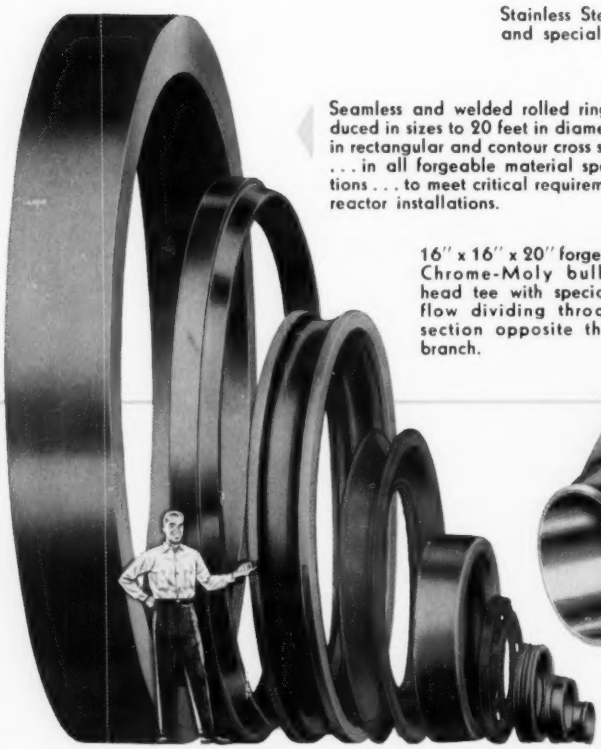
LADI

...THE RECOGNIZED, DEPENDA

Heavy wall laterals closed impression die forged of Stainless Steel in a variety of sizes.

Stainless Steel, heavy wall, reducing tee with extended run section.

Stainless Steel Elbow with heavy wall and special radius for nuclear service.



Seamless and welded rolled rings produced in sizes to 20 feet in diameter . . . in rectangular and contour cross sections . . . in all forgeable material specifications . . . to meet critical requirements of reactor installations.

16" x 16" x 20" forged Chrome-Moly bull-head tee with special flow dividing throat section opposite the branch.

ISH

NDABLE SOURCE FOR

Heat exchanger tube sheet of Stainless Steel. Forged weight — 4220 pounds.

PRODUCED TO OPTIMUM STANDARDS OF METALLURGICAL INTEGRITY AND MANUFACTURING QUALITY...

Outstanding reliability . . . a distinguishing feature of Ladish fittings . . . is the direct result of a combination of skilled craftsmen, Controlled Quality methods, unmatched laboratory and production facilities.

Each step in production from initial verification of material analysis through final inspection is controlled by an extensive staff of quality-conscious metallurgists and engineers.

This continuous painstaking control of production processes assures metallurgical integrity and conformity to specifications.

Unusual Fittings

FOR NUCLEAR AND CONVENTIONAL POWER PIPING APPLICATIONS

Type 304L Stainless Steel Nozzle, drop forged and machined to precision tolerances.

Ladish is widely recognized as a prime, dependable source for a broad range of special-purpose fittings and forgings to meet unusual piping problems.

The fittings shown here were developed in close collaboration with the engineering staffs of firms pioneering in the design of modern conventional power plants and nuclear power installations.

Ladish has extensive experience and unequalled facilities for forging, machining and testing . . . small and large, simple and complex parts, in virtually every forgeable material . . . under precise metallurgical and manufacturing controls.

Largest closed impression die forging produced to date. Weight — 10,500 pounds . . . 316 Stainless Steel. For use in modern power plants operating at elevated pressures and temperatures.

L

TO MARK PROGRESS

Intricately shaped Stainless Steel heat exchanger heads. Drop Forged and machined to close tolerances by Ladish.

LADISH

CUDAHY (Milwaukee Suburb

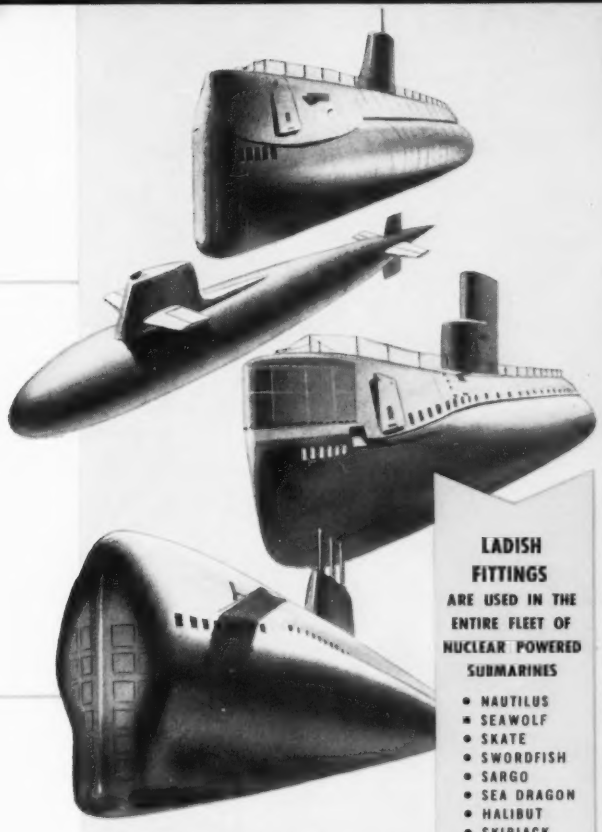
Serving the West . . . Ladish Pacific Division

Serving Canada . . . Ladish Co. of Canada

Complete Service in Controlled

WELDING FITTINGS	ASA & MSS FLANGES	SCREWED and SOCKET FITTINGS and UNIONS

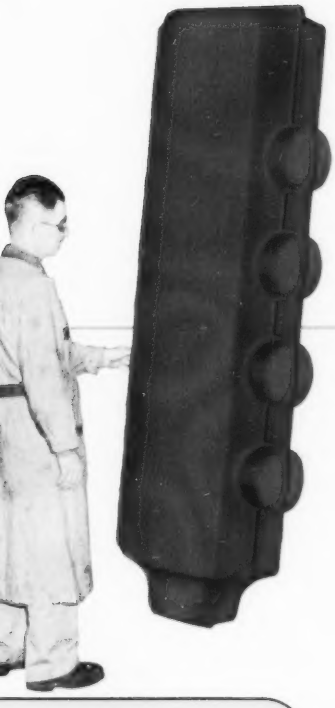
Titanium pipe fittings produced for a number of critical piping installations requiring positive resistance to extremely corrosive media.



LADISH FITTINGS ARE USED IN THE ENTIRE FLEET OF NUCLEAR POWERED SUBMARINES

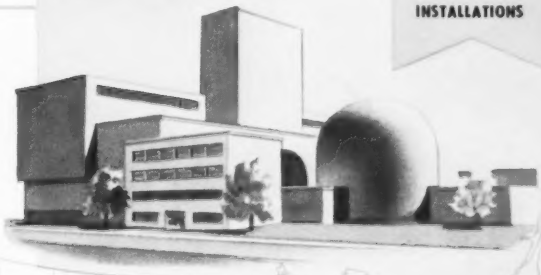
- NAUTILUS
- SEAWOLF
- SKATE
- SWORDFISH
- SARGO
- SEA DRAGON
- HALIBUT
- SKIPJACK
- TRITON

...AND IN PROTOTYPE REACTOR SYSTEMS FOR SURFACE SHIPS



HANFORD • OAK RIDGE • ARGONNE
LOS ALAMOS • PADUCAH
DRESDEN • SANTA SUSANA • DETROIT
SAVANNAH RIVER • PORTSMOUTH
NATIONAL REACTOR TEST STATION
SHIPPINGPORT • BROOKHAVEN

LADISH CONTROLLED QUALITY FITTINGS IN A.E.C. NUCLEAR REACTOR INSTALLATIONS



THESE AND OTHER FITTINGS ARE PRODUCED BY LADISH TO MEET THE UNUSUAL REQUIREMENTS OF MODERN POWER GENERATION.

SH CO.

e Suburb) WISCONSIN

Division, Ladish Co., Los Angeles, Calif.
of Canada Ltd., Brantford, Ontario

ntrolled Quality Fittings

nd	LONG	TEMA & LARGE O.D.
NGS	NECK	FLANGES &
IS	FLANGES	ROLLED RINGS

LADISH *Controlled Quality*

PIPE FITTINGS

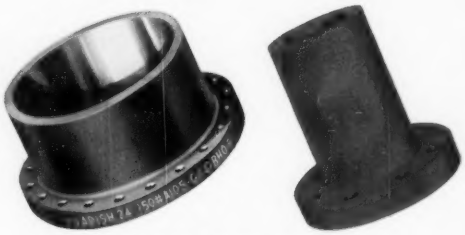
CARBON STEELS • ALLOY STEELS • STAINLESS STEELS • ALUMINUM
TITANIUM • INCONEL • AND WIDE RANGE OF FORGEABLE MATERIALS

IPS BUTT WELDING FITTINGS—½″ thru 42″—Sch. 5S thru 4″ walls

TUBE O.D. WELDING FITTINGS—½″ thru 36″—.049″ thru .250″ walls

ASA and MSS FLANGES—½″ thru 24″—150 lb. thru 2500 lbs.

LARGE O.D. and TEMA FLANGES—
Up to 20′ in diameter



LONG WELDING NECK FLANGES—
1″ thru 24″—150 lb. thru 2500 lbs.

SCREWED and SOCKET TYPE FITTINGS and UNIONS—⅛″ thru 4″—150 lb. and 2000 thru 6000 lbs.

LADISH CO.

CUDAHY (Milwaukee Suburb) WISCONSIN

Serving the West: **LADISH PACIFIC DIVISION, LADISH CO.,** Los Angeles, Calif.

Serving Canada: **LADISH CO. OF CANADA LTD.,** Brantford, Ontario

Sales Offices:

• AMARILLO	• CALGARY	• DENVER	• MILWAUKEE	• PHILADELPHIA	• SAN FRANCISCO
• ATLANTA	• CHARLOTTE	• HOUSTON	• MONTREAL	• PITTSBURGH	• SEATTLE
• BATON ROUGE	• CHICAGO	• LOS ANGELES	• NEW YORK	• ST. LOUIS	• TORONTO
• BUFFALO	• CLEVELAND	• MEXICO CITY	• ODESSA	• ST. PAUL	• TULSA

for cooling tower application...

There's MORE protection against humidity in Allis-Chalmers MOTORS

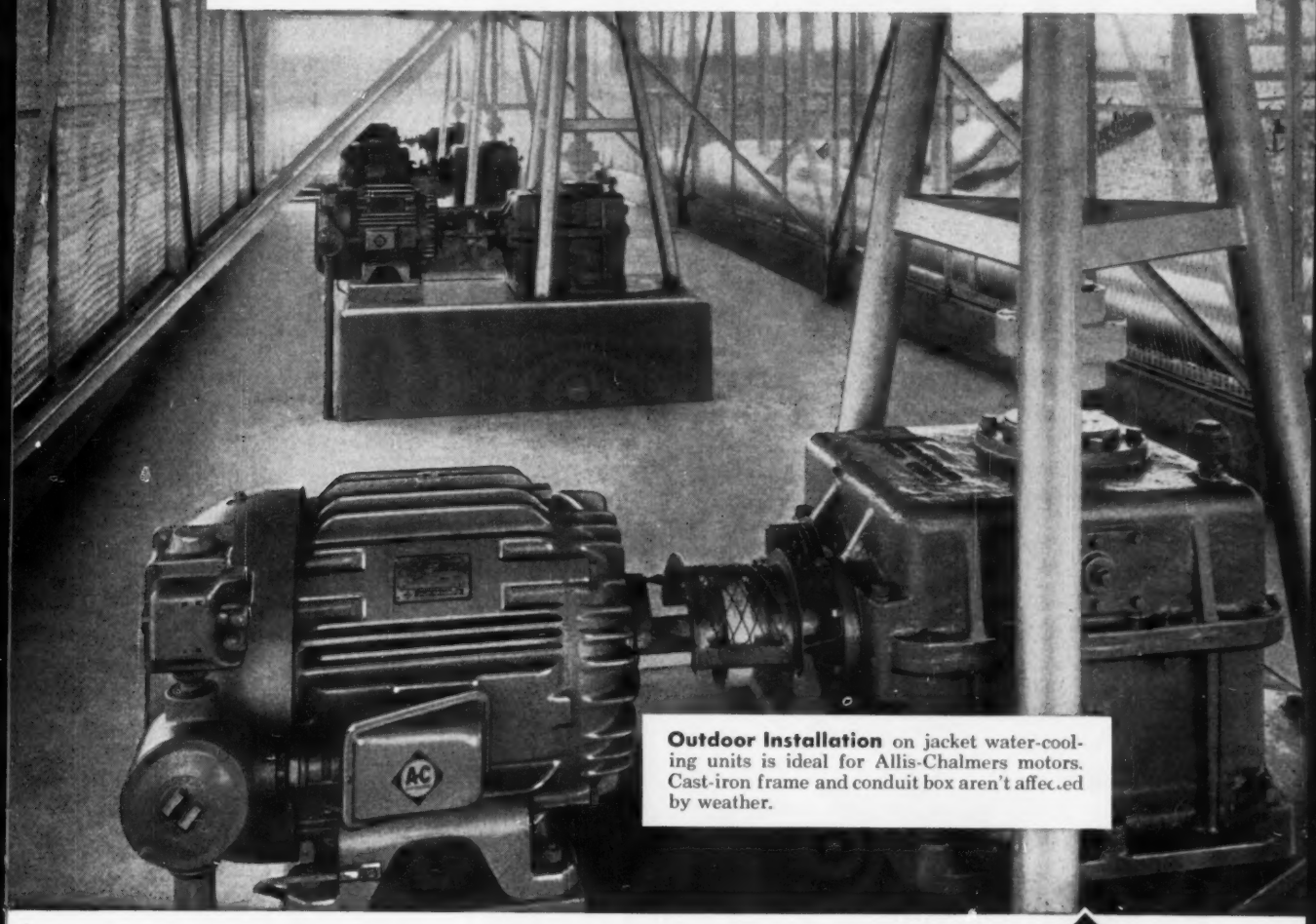
The ultimate in protection against high humidity — major cause of cooling tower motor failure — is provided tower builders and users in Allis-Chalmers TEFC motors. Here's why:

1. **Moisture drainage** — Drain plug can be removed to eliminate condensed moisture in the motor. (Particularly helpful in intermittent operations where condensation is more likely.)

2. **Extra-insulated stator** — Several applications of special insulating varnish plus repeated baking keep humidity out . . . give the long electrical life you need.

3. **Weather-protected bearings** — Rotating seal, turning in close running clearances, guards against entry of water.

Find out more about the "MORE" in Allis-Chalmers motors by contacting your nearby A-C sales office or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wis.



Outdoor Installation on jacket water-cooling units is ideal for Allis-Chalmers motors. Cast-iron frame and conduit box aren't affected by weather.

ALLIS-CHALMERS

A-5183

If you have TUBES or PIPES from ½" to 12" I.D. you can't clean thoroughly

Try ROTOJET®

Rotojet Tube Cleaners, driven by air, steam or water, are made for straight or curved tubes and pipes from ½" to 12" I.D. Send us your problem.

ELLIOTT COMPANY – ROTO PLANT
DIVISION OF CARRIER CORPORATION
Tube Cleaner Specialists Since 1910

153 Sussex Avenue, Newark, N. J.

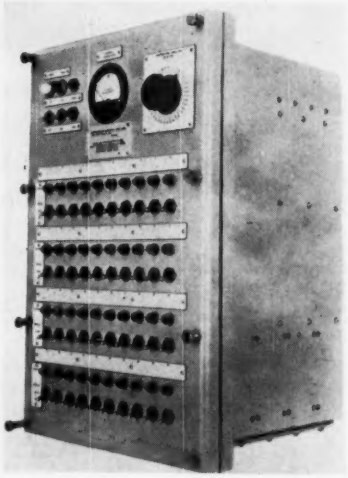
More EQUIPMENT NEWS

Begins on page 158

refrigerants up to a maximum temperature of 212 F. Pressure range is 0 to 300 psi.

The 3-way valves may be changed from normally closed to normally open operation or vice-versa by revolving the valve body 180 deg.

Automatic Switch Co
Florham Park, N. J.

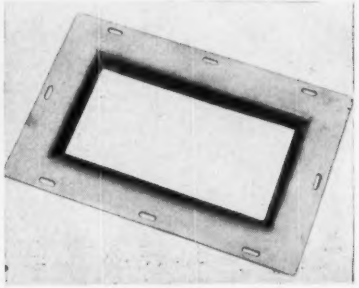


Temperature monitor

1123 • Monitor is a scanning and indicating device said to automatically check temperatures to 40 thermocouples in range of 100 to 400 F, every 10 sec. For use in marine and land-based power plants, scanning circuit scans temperatures and triggers visual and aural alarm systems. Unit monitors any one of 40 thermocouples with manual selector switch. Additional fail-safe relay circuit insures proper functioning, manufacturer claims.

Pickard & Burns, Inc, 240 Highland Ave, Needham Heights, Mass.

For more details on these items, use post cards p 167. Identify your request with item number.



Frame drop-out

1148 • Drop-out is useful whenever a hole is to be cut through the trough itself to a motor or distribution panel. Fitting is bolted to trough bottom and rounded edges protect cable insulation.

Trough is available in 6, 9, 12 and 18 in.

FLUOR PRODUCTS COMPANY
A DIVISION OF THE FLUOR CORPORATION, LTD.

by agreement with

MASCHINENFABRIK HARTMANN A. G.
OFFENBACH/ MAIN, GERMANY

is pleased to announce that it now has
the exclusive license in the
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design, fabrication and sale of

Hartmann Pneumatic and Mechanical Conveying Systems, Ash Handling Systems, Dust Removal and Classifying Systems

YOU ARE INVITED TO SEND REQUESTS
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DIVISION

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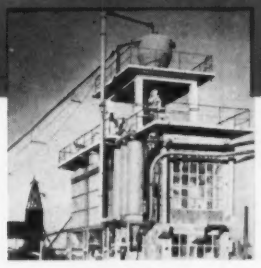
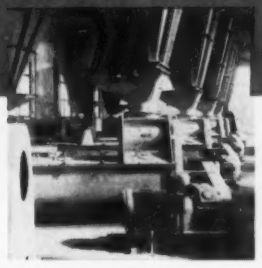
Over 50 Years' Design Experience in a Wide Variety of Industrial Applications...



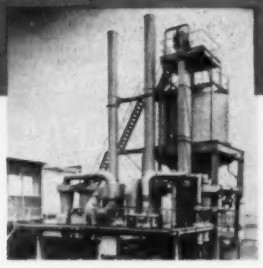
PNEUMATIC CONVEYING

Hartmann has designed, fabricated and installed over 1000 systems for more than 200 different industrial applications. The first, in 1903.



MECHANICAL CONVEYING

In belt, screw, chain, plate and bucket types — experienced in standard and special applications and in combination with pneumatic systems.



DUST REMOVAL SYSTEMS

Fluor-Hartmann designs wet or dry types or combinations of both for critical industrial applications ranging from de-dusting to air sifting.

Sales Offices in: Birmingham, Buffalo, Chicago, Denver, Detroit, Houston, Kansas City, Los Angeles, Minneapolis, New York, Philadelphia, Pittsburgh, San Francisco, Tulsa, Toronto, Ontario

pumping something special?

check these special features

*available with Yeomans Vertical Wet Pit Centrifugal Pumps**

sand glass particles and other abrasives	*Lubri-Vac*® reduces by 95% the failure of bearings due to scoring by abrasive particles. Lubri-Vac constantly flushes bearings with lubricant, keeps foreign matter away. (An exclusive Yeomans feature included on all heavy-duty pumps.)
ash fly ash cinders bits of coal corn foots and other solids contained in drainage	A cradle pump with protective sleeves to protect shaft. Special manganese steel parts. Yeomans pumps including these features will give long life under the most severe abrasive conditions.
potassium cyanide suiphuric acid jet fuel melted naphthalene and other toxic or volatile liquids	Shaft seal is not under liquid pressure with Yeomans Vertical Wet Pit Pumps. This feature eliminates the leakage hazard which is present with horizontal pumps.
molten phosphorous acetic acid hydrochloric acid black liquor and other corrosive liquids	Whatever the corrosive and/or abrasive liquid to be pumped—Yeomans has special ferrous and non-ferrous alloy parts to handle it.

*Vertical Wet Pit Centrifugal Pumps save floor space, require no priming —no costly liquid leaks as stuffing boxes are not under liquid pressure. Capacity range from 5 g.p.m. to 10,000 g.p.m.

YEOMANS

2002-2 NORTH RUBY STREET, MELROSE PARK, ILLINOIS

Since 1898

☐ Please send me the catalog, "Yeomans Heavy-Duty Wet Pit Pumps."

☐ I wish to know how I may see Yeomans' 15 minute film on Wet Pit Pumps.

Name_____

Company_____

Street_____

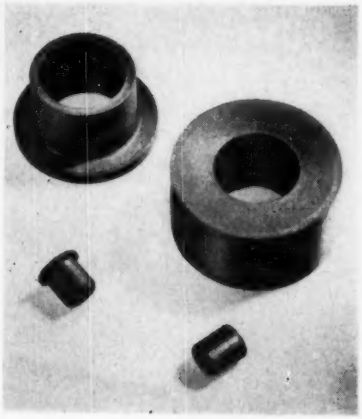
City_____ Zone_____ State_____

More EQUIPMENT NEWS

Begins on page 158

widths and in a variety of sections and fittings. Frame type dropout is available for all widths.

T J Cope Inc
3rd & Walnut Sts, Collegeville, Pa.

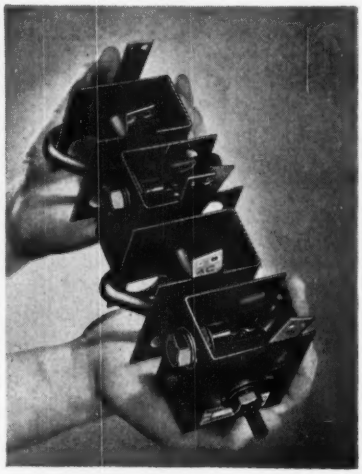


Bearing material

1132 • Developed for applications where lubrication is a problem, composite material is said to need no lubrication. Manufacturer recommends it for: dry bearing services, both sliding and rotating at temperatures to 500 F; use with solvents; applications subject to impact, since it will not permanently deform from shock. The material has static or kinetic coefficient of friction against polished steel of 0.04.

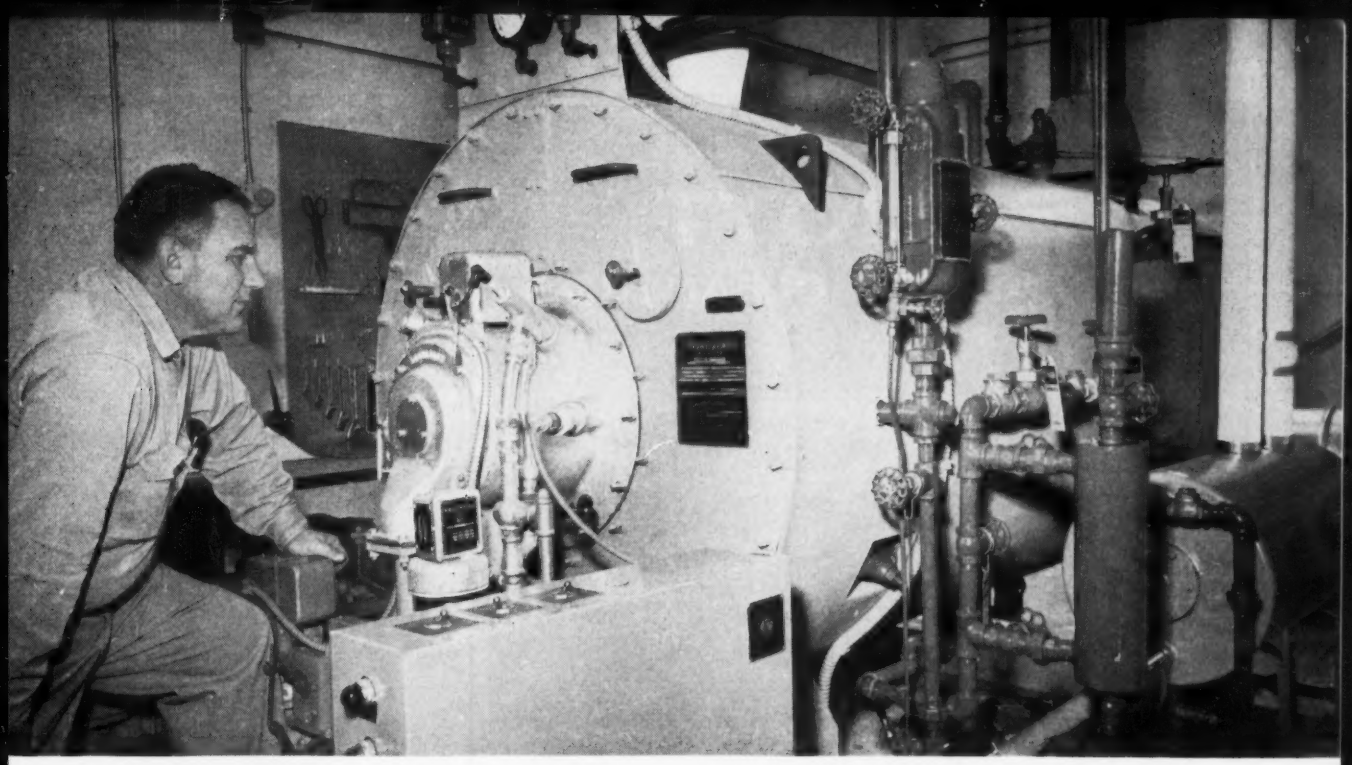
Crane Packing Company
Dept PRN, 6400 Oakton St
Morton Grove, Ill.

For more details on these items, use post cards p 167. Identify your request with item number.

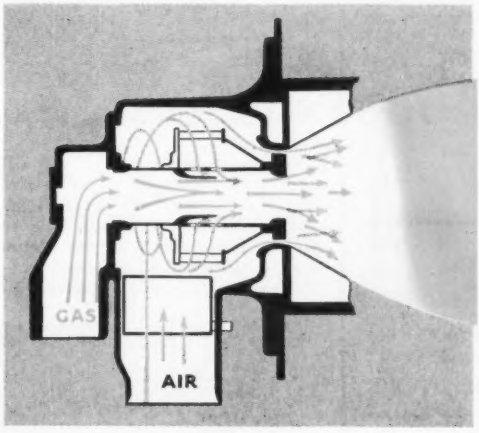


Bridge rectifier stacks

1149 • Heavy power conversion in high ambient temperatures is feature of 23-kw silicon single-phase bridge rectifiers. Units



Why this boiler room would pass the "WHITE GLOVE" test



O&S Gas Burner keeps fuel costs DOWN, boiler efficiency UP

Designed and built by O&S expressly for *Powermaster*, this pre-mix gas burner assures complete, clean combustion over full firing range. Its simple, sturdy construction minimizes maintenance.

Here's the attractive kitchen-clean boiler room of a food extracts manufacturer in Nyack, New York. This gas-fired *Powermaster* Packaged Automatic Boiler makes possible the cleanliness so important to a food products industry such as this. It replaced an oil-fired vertical tubular boiler when the company decided to convert to cheaper gas fuel.

Under widely fluctuating steam demands for cooking kettles, distillation, plant and office heating, the *Powermaster* maintains constant pressure at all loads.

Operating continuously, this completely factory-assembled and fire-tested unit is proving the wisdom of the modernization by its economy, dependability and time-saving automatic operation.

Here's what the Plant Engineer says about the boiler: "I think the *Powermaster* boiler is one of the finest package units available. We like the unit because of simplicity of operation, constant trouble-free steam load provided, the protective and safety devices incorporated in the unit, and the exceptionally good wiring job on the unit.

"I highly recommend the *Powermaster* boiler to other manufacturers." Write today for bulletin.

Powermaster®

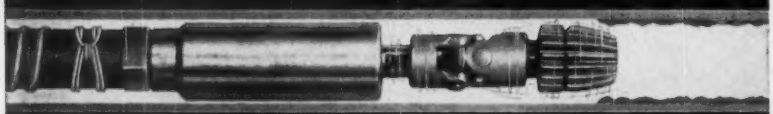
PACKAGED AUTOMATIC BOILERS

Builders of Dependable Boilers Since 1885

ORR & SEMBOWER, INC.

Morgantown Road, Reading, Pa.

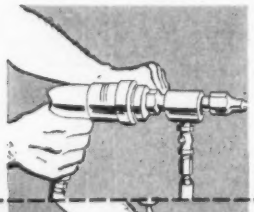
ELLIOTT
SMALL TUBE CLEANERS



types to do all jobs
quickly and effectively

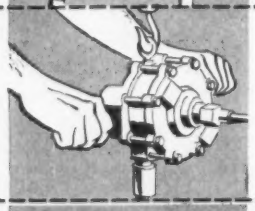
ELLIOTT 600 SERIES for small tubes—straight or curved

These air- or steam-driven motors are excellent for routing light scale in tubes with inside diameters from 5/8" to 1 3/4". Various types of cutter heads and brushes are available for specific tube cleaning requirements.



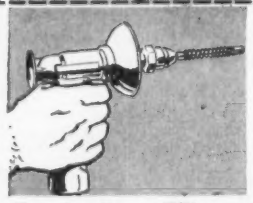
ELLIOTT 5100 SERIES lightweight cleaner for removing medium scale

Air-driven motor with trigger action for motor control, finger-action valve for water flow, built-in speed governor and oil reservoir. Two sizes.



ELLIOTT SUSPENSION SERIES for heavily scaled straight tubes

Air, steam, or electric motor drives shaft fitted with drill or brush head. Motor is suspended outside, shaft and head enter tube.



ELLIOTT JIFFY GUN for extra-fast cleaning of light accumulations

Simply insert nozzle into tube and push. Released air or water pressure shoots nylon brushes or rubber plugs through condenser or heat exchanger tubes. For tubes 1/2" to 1".

For details on Elliott tube cleaning and maintenance equipment, contact Elliott District Office or write Elliott Company, Lagonda Division, Springfield, Ohio.

Y7-1

ELLIOTT Company
Headquarters for Tube Cleaners and Expanders

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

More EQUIPMENT NEWS

Begins on page 158

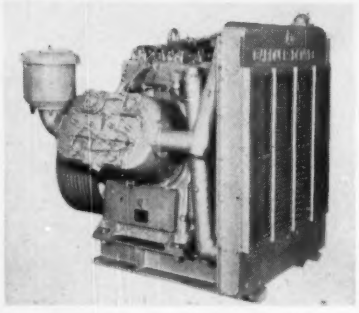
are designed for forced air or natural convection cooling and consist of four silicon junctions mounted on a heat exchanger.

Single-phase unit is rated at 50 amps rectified dc when convection cooled, and 120 amps rectified dc when forced-air cooled at 1000 cfm. Maximum input voltage per junction is 300 PIV, or 210 voh rms.

According to manufacturer, conservative ratings of individual silicon junctions assure high efficiency in operation at base temperatures to 155 C; provide a wide safety factor for normal industrial and military applications. Hermetic sealing of individual junctions permits use in extremely corrosive atmospheres.

International Rectifier Corp
1521 E Grand Ave, El Segundo, Calif.

For more details on these items, use post cards p 167. Identify your request with item number.



Compact air compressor

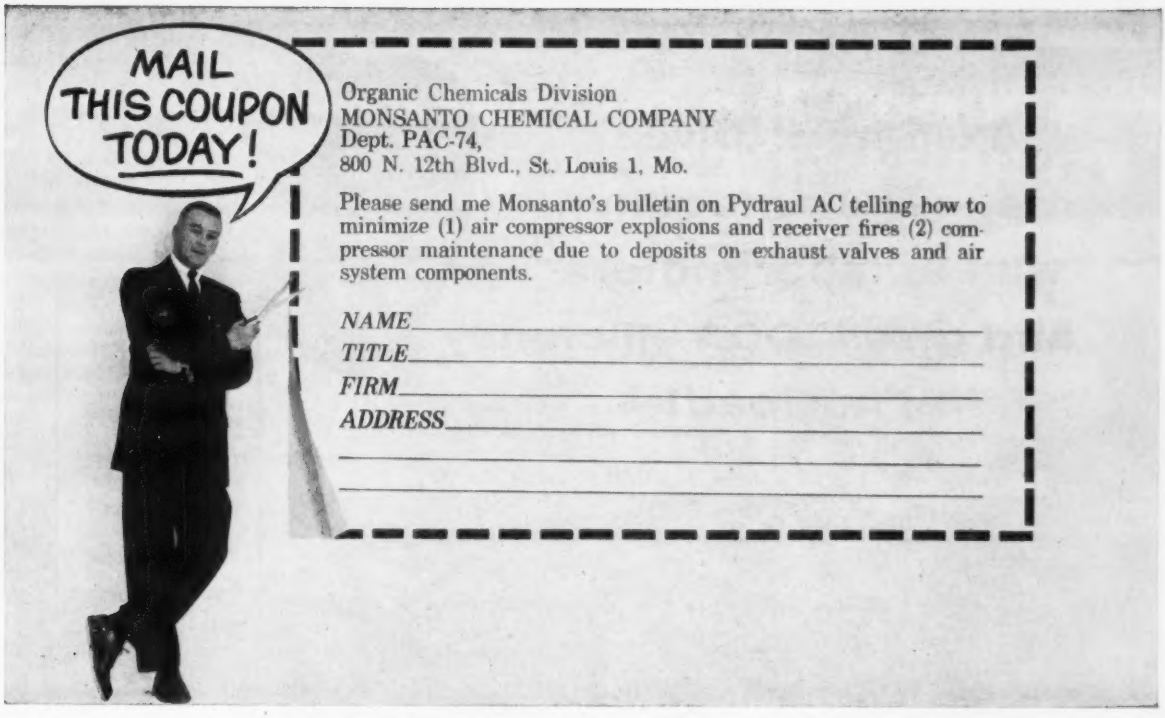
1135 • Model *WBN* is a 200-hp 2-stage unit that occupies only 34 sq ft of floor space. The packaged unit needs no special base, is said to operate with little attention. Available with tube-type intercooler or self-contained radiator-intercooler.

Gardner-Denver Co, Quincy, Ill.

Wiring raceway

1134 • Channel, made of reinforced phenolic, is said to be completely self-extinguishing without after-glow. Unit is lightweight, durable, and does not warp or sag.

Stahlin Brothers, 474 Maple St
Belding, Mich.


MAIL THIS COUPON TODAY!
Organic Chemicals Division
MONSANTO CHEMICAL COMPANY
Dept. PAC-74,
800 N. 12th Blvd., St. Louis 1, Mo.
Please send me Monsanto's bulletin on Pydraul AC telling how to minimize (1) air compressor explosions and receiver fires (2) compressor maintenance due to deposits on exhaust valves and air system components.
NAME
TITLE
FIRM
ADDRESS

Want to reduce fire hazard in your air compressors?... Read Monsanto's bulletin on Pydraul AC

When flammable oil mists and films gather in your compressed air system . . . you have a real fire risk!

Ease your mind—there's a new, fire-resistant lubricant to protect your equipment, your workers and your production flow from compressor fires and explosions caused by flammable oils. Simply replace your ordinary petroleum oils with fire-resistant Pydraul AC compressor lubricant.

Pydraul AC is chemically made, not a water-soap base mixture, not a petroleum oil. It's a completely new type of bearing-protecting lubricant. Pydraul AC is created especially for air compressors. With Pydraul AC lubrication you ease your mind about compressor fires and explosions. You may also reduce maintenance costs because Pydraul AC can minimize carbon deposits on air compressor exhaust valves and air piping systems.

There's no conversion problem—just drain out the flammable lubricant and replace with fire-resistant Pydraul AC—it's that easy!

For more facts—fast: Just mail the coupon today for the new Monsanto bulletin on Pydraul AC. No cost to you. It shows properties, field experience, operating economies, etc. Act *now.* Mail coupon *today!*

There's also a fire-resistant Pydraul for every industrial hydraulic job:

- General-purpose Pydraul F-9
- Pydraul 150 and Pydraul 60 for precision equipment
- Pydraul 600 for heavy equipment

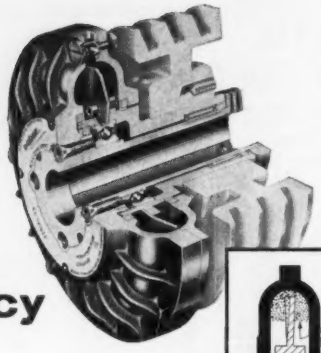
PYDRAUL: Reg. U. S. Pat. Off.

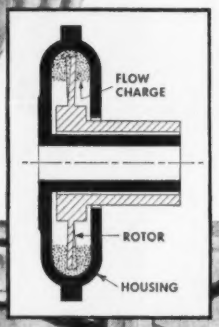
MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
Dept. PAC-74, 800 N. 12th Blvd., St. Louis 1, Mo.

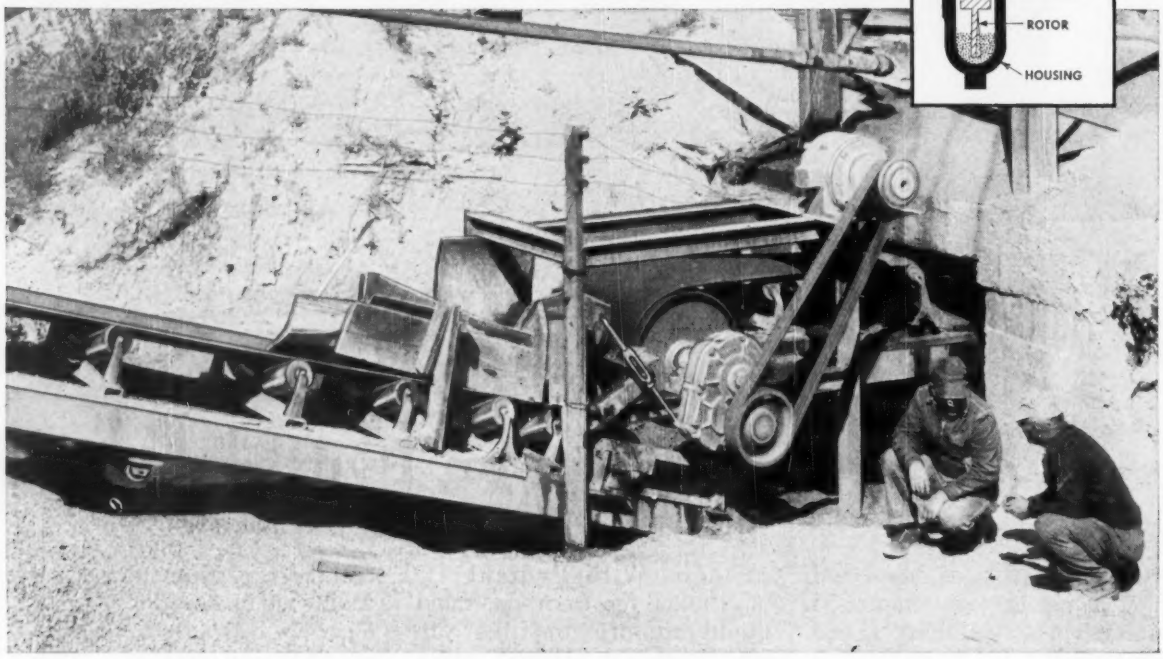
MONSANTO

Where Creative Chemistry Works Wonders For You

This new drive starts loads smoothly... with smaller motors ...and gives 100% efficiency at full load!







FLEXIDYNE

THE DRY FLUID DRIVE

This tunnel conveyor, 225 feet long, handles 500 tons of sand and gravel per hour—8 to 16 hours a day.

With Flexidyne, the motor picks up the load easily and smoothly. Power investment is reduced, power costs cut, maintenance simplified and conveyor belts are protected against breakage.

Flexidyne, the Dry Fluid Drive, is the *new* development that starts loads smoothly, that protects against shocks and overloads, that saves power and that gives 100% efficiency at full load!

The "dry fluid" in Flexidyne is heat treated steel shot. A measured amount, called the flow charge, is contained in the housing, which is keyed to the motor shaft. When the motor is started, centrifugal force throws the flow charge to the perimeter of the housing, wedging it between the housing and the rotor which transmits power to the load.

After a momentary slip between housing and rotor, the two become locked together and achieve full load speed without slip and at 100% efficiency during the running cycle. Changes in weather—hot or cold—inside or out—do not affect operation of Flexidyne.

Flexidyne is now available in 8 sizes—for use with electric motors and internal combustion engines from 1 hp to 300 hp. While each size is power rated, the flow charge can be varied at will to give tailor-made torque for your particular job. Write for Bulletin A-640.

DODGE MANUFACTURING CORPORATION
3200 Union Street, Mishawaka, Indiana

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in in your classified phone book, or write us.

DODGE
of Mishawaka, Ind.

More TECHNICAL BRIEFS

Begins on page 154

ious distances above the hot body, and, more particularly, to its rate of convective heat release.

The authors desired to express the relationship in the form of a general equation by which the design engineer could estimate the cross-sectional dimensions, velocity and overall rate of flow of the rising air stream at any desired distance above a given piece of hot-process equipment where an exhaust hood was to be placed. *ASHAE paper, no number.*

Cold-wall effects in a ceiling-panel-heated room. *By L F Schutrum and T C Min, ASHAE Research Laboratory.*

Room-side temperature of a wall or all-glass wall exposed to winter outdoor conditions affects the air temperature, air movement and radiant conditions within the room. In a test room heated by a ceiling panel, one whole wall was cooled to simulate the inside temperature of an exposed wall. The ceiling was heated in panels 4, 8, and 12 ft wide and the panel temperatures selected to maintain a constant 70-F room-air temperature. Room-air temperatures, air velocities and mean radiant temperatures were measured under steady-state conditions and are reported in this paper.

In the living space, variations in room-air temperatures were found to be small; and room-air velocities were negligible except near the floor. Mean radiant temperatures were, in general, higher than the room-air temperature. *ASHAE paper, no number.*

Thermal design of warm water concrete floor panels. *By a subcommittee of technical advisory committee on Panel Heating and Cooling, and staff members of the ASHAE Research Laboratory.*

This paper presents a simplified procedure for thermal design of water-heated floor panels for use in residences and commercial buildings. It complements a previously-published paper, "Thermal design of warm water ceiling panels," by the same authors. *ASHAE paper, no number.*

Performance of covered hot-water floor panels. *By E L Sartain, Modine Mfg Co, and W S Harris, University of Illinois.*

This paper is the second of a series concerning the panel-heating investigation being conducted at the University of Illinois in co-operation with the Institute of Boiler and Radiator Manufacturers. Scope of these papers is limited to studies of concrete panels at grade level.

Part 1 contained a discussion of the effects of various floor coverings on the thermal characteristics of floor panels. Part 2 is concerned with room conditions. Studies of room conditions include consideration of room-air temperature and velocity; slab, floor covering, wall, glass and ceiling surface temperatures; heat flow from panel to room; and relative humidity produced in the test rooms. *ASHAE paper, no number.*

Directions for ordering papers on p 204

Gas Turbines

Gas turbine operating experience of West Texas Utilities Co. *By A R Cox, West Texas Utilities Co.*

Paper presents a summary of West Texas Utilities Co's gas-turbine generating experience covering operation and maintenance from December, 1952 to August, 1956. Tabulated operating and maintenance cost data is included.

Experience with two units is described. The No. 1 unit, located at Fort Stockton, Texas, is an independent plant. A second unit is to be placed in service in the spring of 1958. The No. 2 unit, located at Girvin, Texas, is an application of a combustion gas turbine to the cycle of an old steam plant.

Both units are simple-cycle type gas turbines coupled directly to the axial-flow air compressors. They drive the generators through reduction gears at 3600 rpm. Fuel is natural gas at 150-psi throttle pressure. *ASME paper, No. 57-GTP-11.*

Analytical methods for performance estimates of free-piston gasifiers. *By A R Bobrowsky, Ford Motor Co.*

The performance of a free-piston gasifier may be predicted by preliminary calculation as was shown by London and Oppenheim. The author describes procedures attempting to both extend the scope and increase the depth of inquiry over previous analytical techniques.

The procedure set up differs from previous procedures in that (1) Off-design operation is examined. (2) Simple stability evaluations are made. (3) Operation-dependent variables are obtained iteratively (e.g., pressure drops, degree of afterburning, etc). (4) The concept of minimum geometry is presented. (5) Fields of operation are defined. (6) Synthesis of control patterns is relatively easy. (7) Speedy approx-

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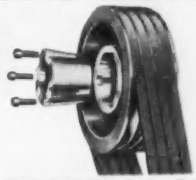

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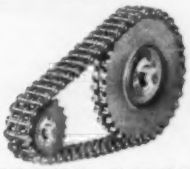

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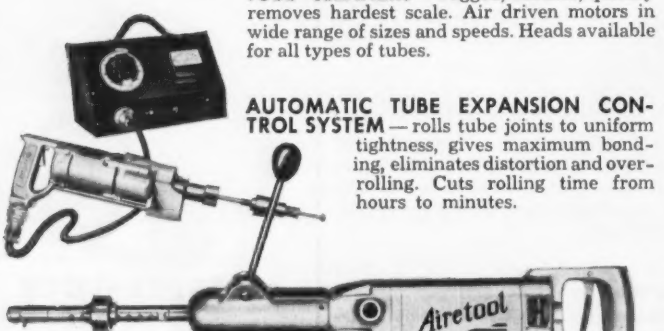

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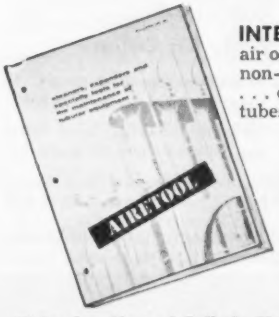

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More TECHNICAL BRIEFS

Begins on page 154

imations of frequency and performance may be made by procedures based on engineering-mechanism foundations.

Predictions of performance data showed reasonable correlation with experimental results. *ASME paper, No. 57-GTP-6.*

Design features of new 16,500-kw gas turbines for power generation. *By A O White, General Electric Co.*

The combustion gas turbine is an accepted means of power generation in the world today, and there is a demand for ever-increasing sizes. To meet this demand, the author's company embarked on design of a unit to be rated at about 15,000 kw.

As the design developed, the proportions of the compressor and turbine were selected to give maximum economic output at 3600 rpm in a simple-cycle single-shaft unit. Final rating of the units, as presently designed, is 16,500 kw at 80 F and 1000-ft altitude.

Paper describes the compressor design, combustion system, turbine design, bearings, couplings and shafts, accessories and control, and installation. *ASME paper, No. 57-GTP-1.*

Large gas turbines for the British Columbia Power Commission. *By A O White, General Electric Co.*

Early last year, the British Columbia Power Commission ordered four large gas turbines for a new thermal power plant on Vancouver Island. When this plant goes into service it will be the largest gas turbine installation in the world. The units are the largest single-shaft gas turbines built to date.

The first two units are of a simple-cycle single-shaft design, directly coupled to a hydrogen-cooled generator, 25,600 kva, 0.85 pf at 30 psig hydrogen pressure, 13,800 v, 3 ph, 60 cycles. The second two units are regenerative-cycle single-shaft units, coupled to similar generators by a flexible quick-disconnect coupling. All four generators can be uncoupled from the gas turbines and run as synchronous condensers when desired, but the special coupling enables the changeover to be accomplished very quickly on the regenerative units.

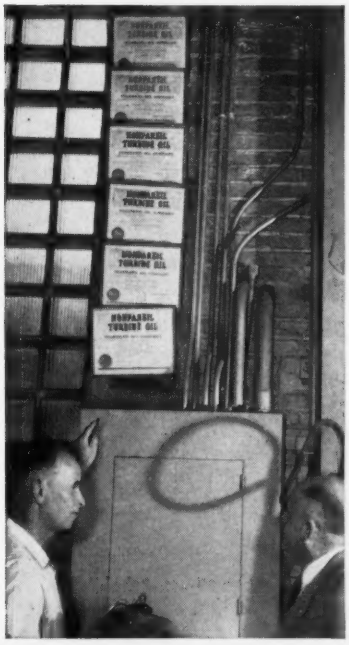
The simple cycle units are rated 19,750 kw at 50 F and 200-ft altitude; the regenerative-cycle units are rated 18,000 kw at 50 F and 200-ft altitude. All will burn bunker C oil, which will be treated at the site to the turbine manufacturer's specifications to elimi-

Directions for ordering papers on p 204

They packed up turbine oil worries at Alton Box Board

six turbines use NONPAREIL Turbine Oil, have life-of-turbine guarantee

Six NONPAREIL Turbine Oil guarantee certificates on the turbine room wall are pointed out by M. D. Jones, Superintendent of the Power and Steam Department. Standard Oil Company's lubrication engineer, W. P. "Sandy" Wehking, helped put most of the certificates there.



Alton Box Board Company, Alton, Illinois, doesn't have a worry in the world about turbine oil. The Company has six turbines in service—four in the power plant and two in the paper mill—all using NONPAREIL Turbine Oil. Why no worries? Because each of these fills of turbine oil is *guaranteed for the life of the turbine* not to exceed a neutralization number above 0.15 mg. KOH/g.

The five Westinghouse and one G-E turbine oil fills have demonstrated a remarkable low acidity record over the years. Regular inspection by Standard Oil technical service representatives and analysis of oil samples by the Standard Oil Research Laboratory, Whiting, Indiana, makes sure the oil is performing in accordance with the guarantee. At Alton Box, neutralization number of the oil has been running 0.02 to 0.03 mg. KOH/g.

This is what such service from a turbine oil means to Alton Box Board: They can run one of the largest board mills in the world without having to concern themselves with the performance of the turbine oil they are using. Standard Oil technical service men inspect the system. The oil is sampled and analyzed regularly. Plant operation will never be interrupted because of turbine oil lubrication failure.

The same performance from NONPAREIL Turbine Oil and service from Standard Oil awaits you. Find out. Call your nearby Standard Oil office near you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

How NONPAREIL Turbine Oil is performing at Alton Box Board

Make of Turbine	kw. (H.P.)	Year NONPAREIL Installed	Location	Gal. fill.	Neut. No. mg. KOH/g.
Westinghouse	1,500	1934	Power Plant	85	.02
Westinghouse	3,125	1936	Power Plant	275	.03
General Elec.	400	1936	Paper Mill	50	.02
Westinghouse	1,500	1941	Power Plant	250	.03
Westinghouse	5,000	1947	Power Plant	230	.03
Westinghouse	1,500	1947	Paper Mill	80	.02

Discussing lubrication. Sandy Wehking, Standard's man on the Alton Box Board account, is well qualified to do so. He's been at this work for 15 years. Sandy studied chemical engineering at Blackburn College. He has also completed the Standard Oil Sales Engineering School.

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Thousands of BS&B Safety Heads are today protecting millions of dollars worth of property and equipment and countless human lives. There's a BS&B Safety Head suitable for many types of pressure systems containing air, gas, steam or liquid.

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BS&B rupture discs are designed to relieve pressures at any specified point from 3 to 100,000 pounds per square inch. They are available in standard sizes ranging from ¼ inch to 36 inches in diameter, and in special sizes and types for virtually any application.

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More TECHNICAL BRIEFS

Begins on page 154

nate corrosion problems in the high-temperature parts and to minimize deposits.

The paper goes on to describe the different units. *General Electric Co bulletin, No. GER-1334.*

Power generation

Integration of hydro and thermal power resources in Alberta. *By M M Williams, Calgary Power Ltd.*

The populated area of Alberta (approximately the southern half of the province), receives electric service from an extensive network of high-voltage transmission lines that link all the major production facilities in the province. This facilitates the joint development of a substantial hydro power potential and large reserves of low-cost coal and natural gas.

Large thermal-electric plants are being designed and constructed for base load operation and hydro plants are being extended to supply the peak load needs. Fuel cost of 10½c per million Btu or less, and low-operating costs (by the use of central control equipment) enable Calgary Power Ltd to produce base load energy at a lower cost in thermal plants than possible from the remaining hydro sites. Peaking capacity can, in general, be provided more economically from automatically controlled hydro plants.

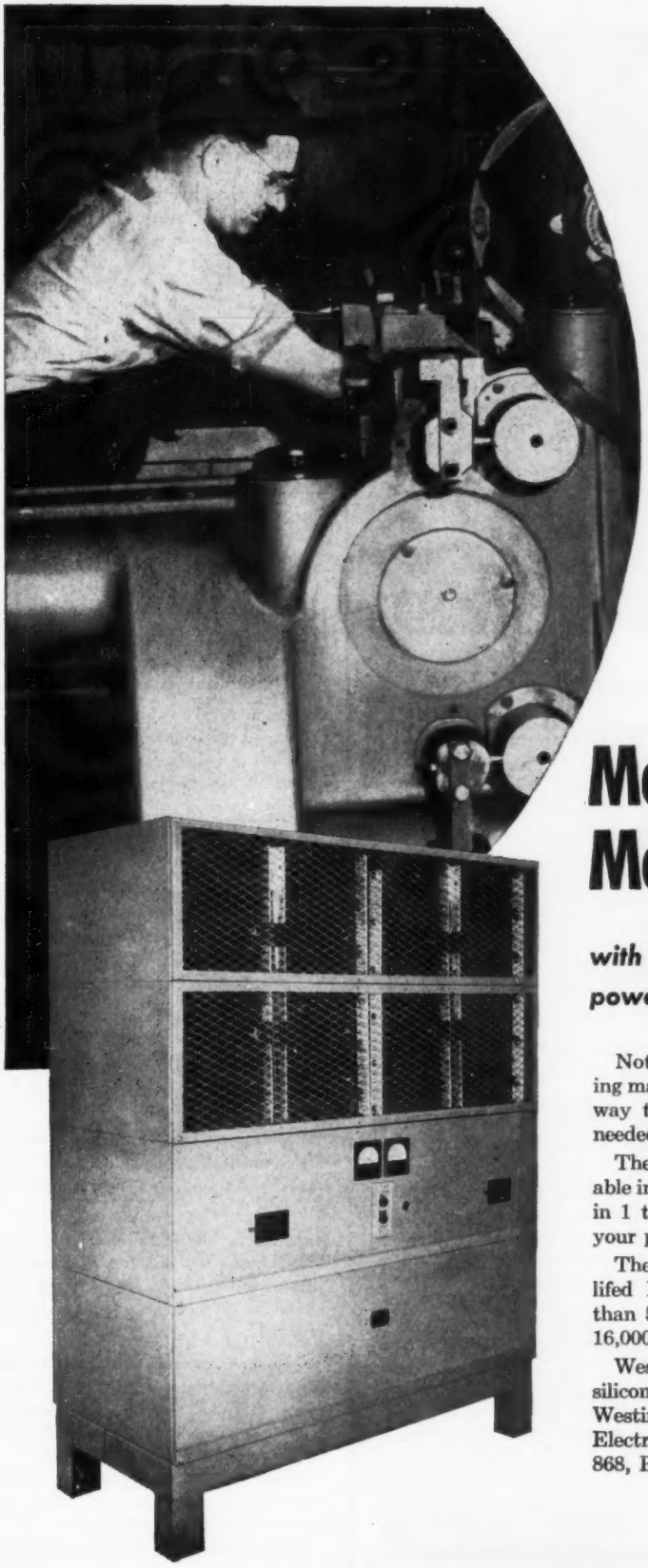
Paper describes Alberta's energy resources and the integration of thermal and hydro plants. *AIEE paper No. 57-694.*

The design and performance of modern large turbine-generators. *By B M Cain and Dean Harrington, General Electric Company.*

Advancements in the art of design and construction of large turbine generators have brought about marked improvements in the familiar designs of these machines. New methods of cooling give machines new and different characteristics. The physical sizes of conventionally cooled generators are largely determined by their heat-dissipating ability. Their efficiency is not greatly influenced by their physical size.

Conductor-cooled generators, on the other hand, have such increased heat-dissipating ability that their size is determined almost entirely by other factors. The balance of such economic considerations as generator size and

Directions for ordering papers on page 204



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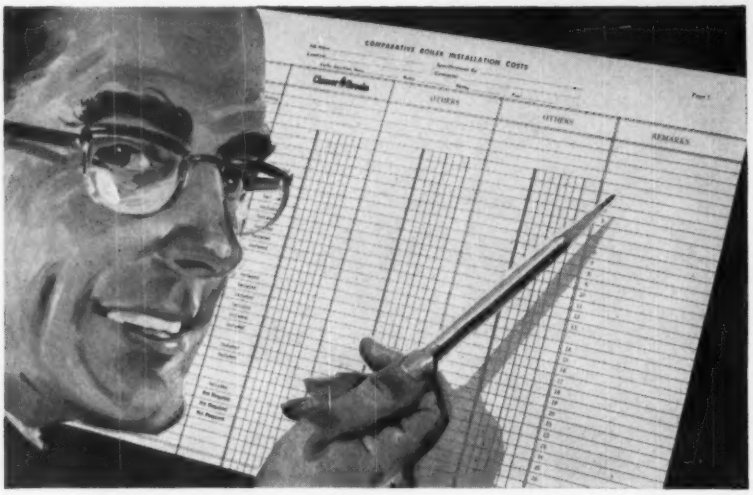

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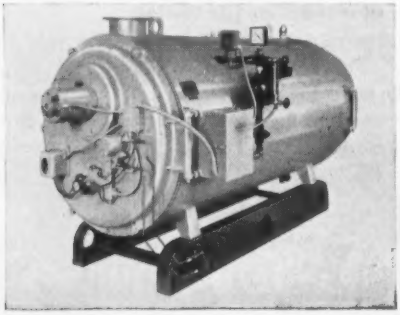

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Begins on page 154

efficiency tends to govern the design of machines with this type of cooling. Losses are an interrelated function of machine size, hydrogen pressure, coolant pumping pressure, and the geometry of the coolant passages. The choice of hydrogen pressure for maximum capability is affected by such performance characteristics as efficiency, short-circuit ratio, and capability in air.

The paper shows how these various factors are related and the way in which their influence is brought to bear, first, on the choices made while the generator is being designed and second, on the performance of the generator after it is installed. *AIEE paper No. 56-190.*

Standards

Standard for the installation on centrifugal fire pumps, May 1957. *By National Fire Protection Association. NFPA pamphlet No. 20.*

Standard for the installation of oil-burning equipment, May, 1957. *By National Fire Protection Association. NFPA pamphlet No. 31.*

Flammable liquids code, May, 1957. *By National Fire Protection Association. NFPA pamphlet No. 30.*

Standard procedures for cleaning or safeguarding small tanks and containers, May, 1957. *By National Fire Protection Association. NFPA pamphlet No. 327.*

Recommended regulatory standard for tank vehicles for flammable liquids, May, 1957. *By National Fire Protection Association. NFPA pamphlet No. 385.*

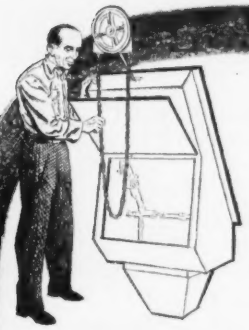
Tentative standard for solvent extraction plants. *By National Fire Protection Association. NFPA pamphlet No. 36T.*

Standard for the installation and operation of gas systems for welding and cutting, May, 1957. *By National Fire Protection Association. NFPA pamphlet No. 51.*

Proposed American Standard dimensions for multiple V-belts and V-belt drives, ASA-B55.1-195X. *By Sectional Committee B55 on the Standardization of V-belts and V-belt drives.*

ASME announces distribution of this proposal for criticism and comment. Interested parties may obtain copies of the tentative draft without charge

Directions for ordering papers on page 204



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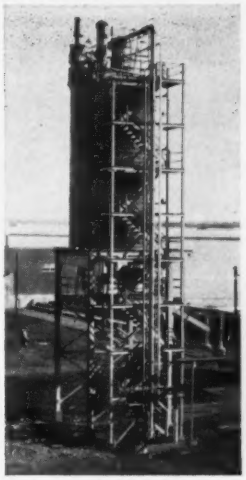
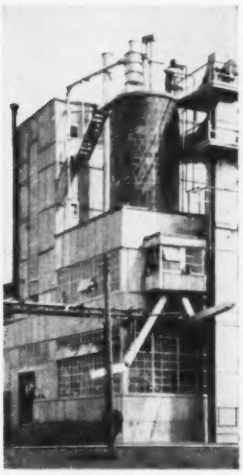
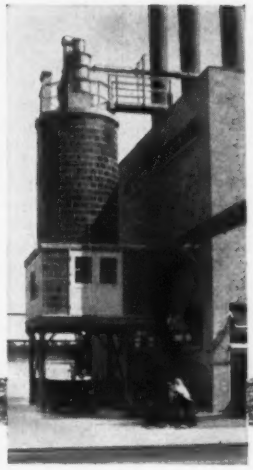




Ash Silo constructed integrally with boiler house. Ash Conditioner mounted inside building. Bifurcated chute allows R.R. car or truck loading.



Ash Silo for truck loading with enclosed room for ash conditioner.

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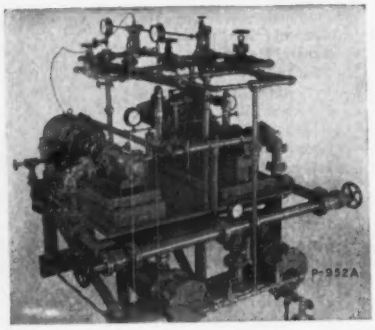

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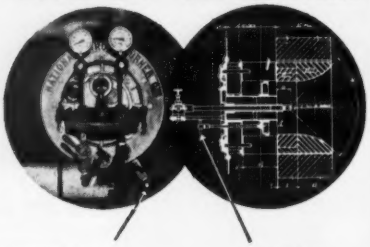

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INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

More TECHNICAL BRIEFS

Begins on page 154

by addressing *Frank Philippbar, Standards Dept, ASME, 29 W 39th St, New York 18, N. Y.* All requests should be made on company letterhead.

Standard for bulk oxygen systems at consumer sites, May, 1957. *By National Fire Protection Association. NFPA pamphlet No. 566.*

Code for the installation and operation of pulverized coal systems, 1956. *By National Fire Protection Association. NFPA pamphlet No. 60A.*

Standard for the storage and handling of liquefied petroleum gases, May, 1957. *By National Fire Protection Association. NFPA pamphlet No. 58.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Society of Mechanican Engineers, Identified by initials ASME and obtainable from ASME, 29 W 39th St, New York 18, New York.

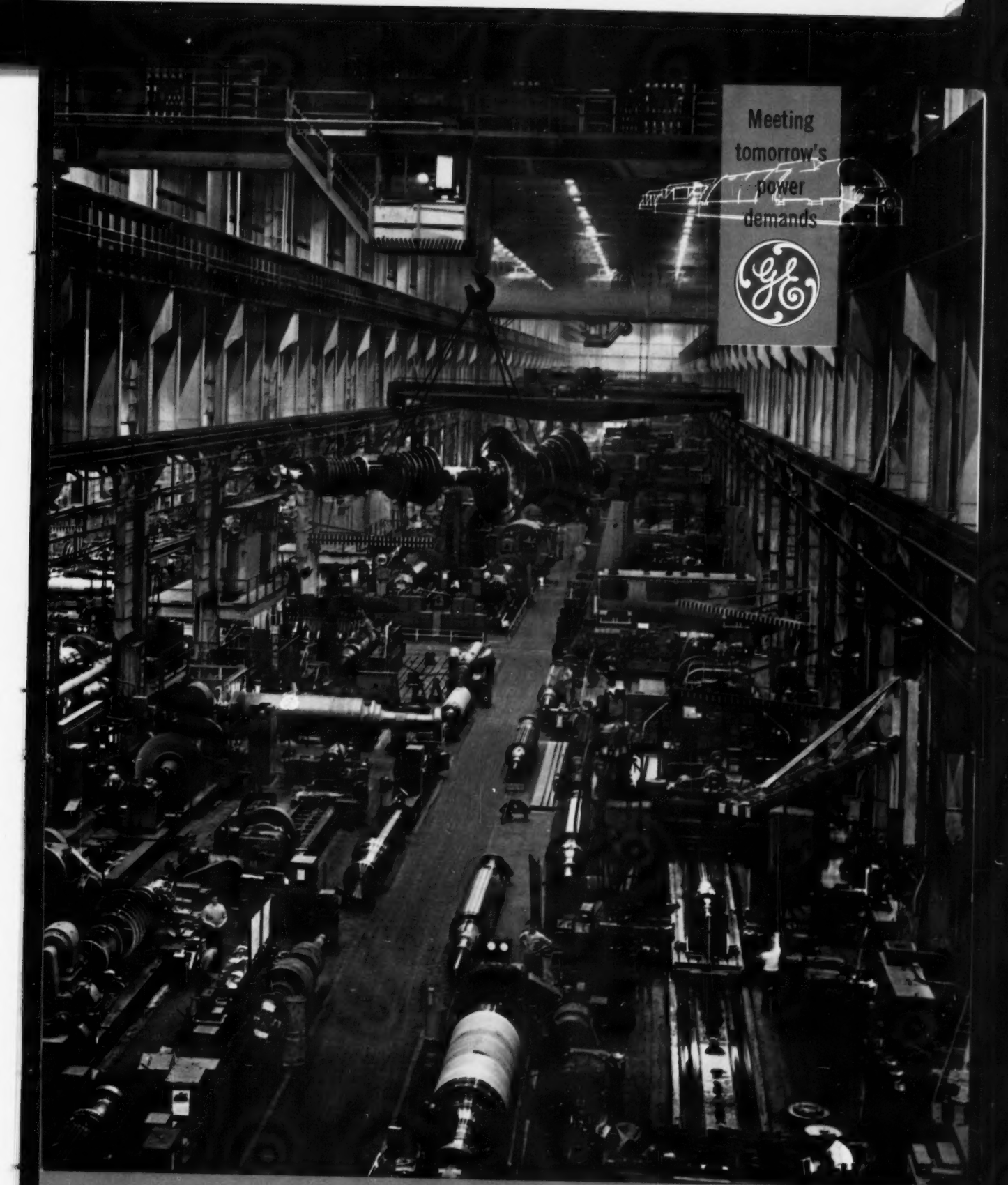
American Institute of Electrical Engineers. Identified by initials AIEE and obtainable from AIEE, 33 W 39th St, New York 18, New York.

Atomic Industrial Forum, Conference on Management, Economics, and Technology for the Atomic Industry. Identified by initials AIF, and obtainable by purchase from AIF, 3 E 54th St, New York 22, N. Y.

National Fire Protection Association. Identified by initials NFPA and obtainable through purchase from NFPA, 60 Batterymarch St, Boston 10, Mass.

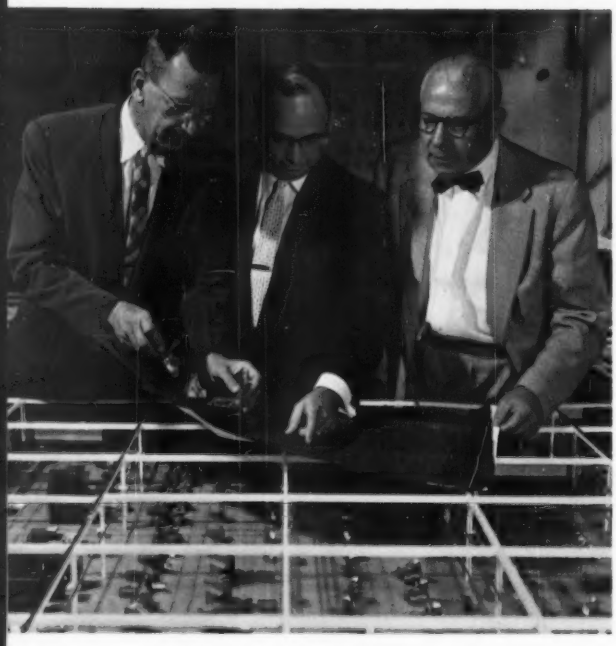
American Society of Heating and Air Conditioning Engineers. Identified by initials ASHAE and obtainable from ASHAE, 62 Worth St, New York, N. Y.

Construction has begun on a four-million gal oil tank for Portland General Electric Co's Station "L" steam plant. Originally designed in 1910 to use "hog fuel" lumber-mill waste as basic fuel, plant has had to be converted due to dwindling supply of lumber scrap in the Portland area, will now use oil and gas.



How General Electric speeds turbine-generator production

Advanced machines and techniques improve General Electric's turbine-generator output



Expanded facilities will soon add to the production capacity of the large steam turbine-generator plant. Shown reviewing expansion plans are H. R. Hill, Mgr-Manufacturing, C. A. Lilly, Mgr-Marketing, and W. E. Saupe, Gen'l Mgr.

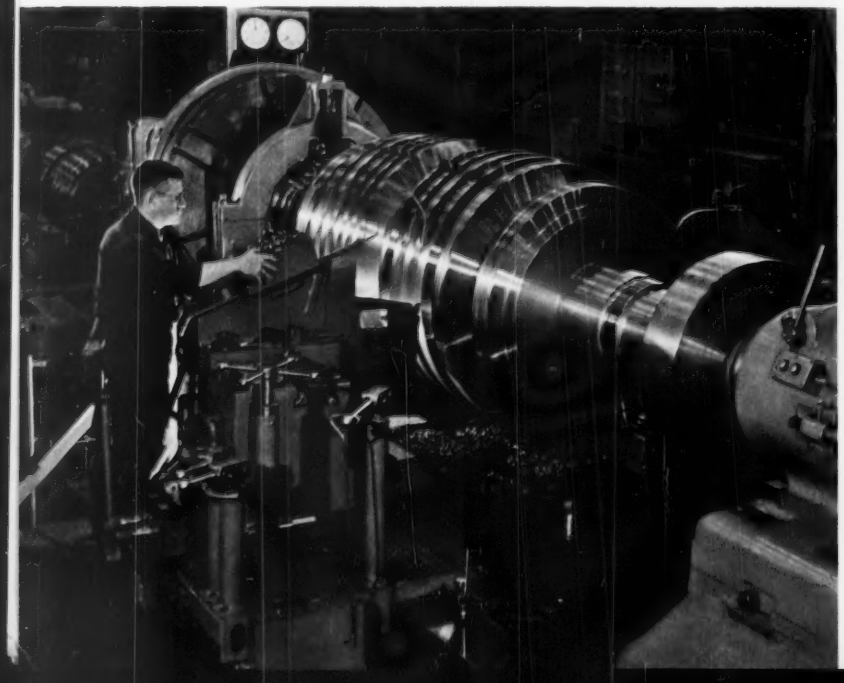
Meeting the requirements of the constantly expanding electric utility industry sets a challenge that is answered by General Electric's continued investment in its large steam turbine-generator manufacturing facilities in Schenectady.

New machine tools – some of them the largest ever made and the only ones of their type – add to the production efficiency required to build precision turbine-generator components, many with tolerances as close as those of a fine watch. Combined with General Electric's organization of skilled craftsmen and turbine-generator engineers, these tools and facilities provide the flexibility needed to keep pace with today's rapid advances in turbine-generator technology. And, in building tomorrow's even more efficient and reliable machines of advanced design, this combination will help maintain a well-established reputation for meeting delivery commitments.

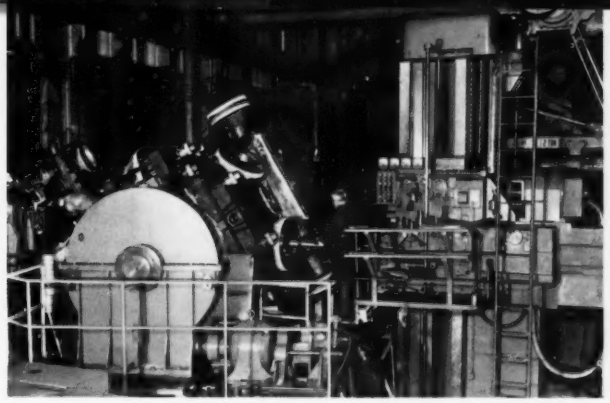
A few of the facilities in the large steam turbine-generator plant that contribute to these outstanding achievements are shown here.

GENERAL ELECTRIC

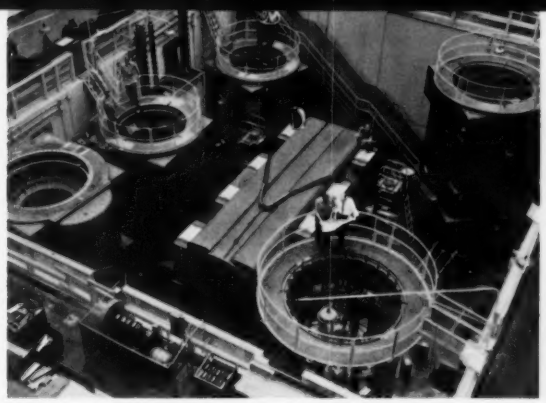
Grooving lathe removes metal from this turbine rotor at the rate of 100 cubic inches per minute – can take 25-ft forgings weighing up to 100 tons and is equipped to machine deep grooves up to 2½ inches wide.



Traveling reamer brings machine to job. Here, unit reams holes in turbine wheel and dovetails of 43-inch buckets.



Horizontal boring mill has special fixture for positioning and machining 100-ton turbine shells at complex angles. This unique arrangement considerably reduces set-up time.



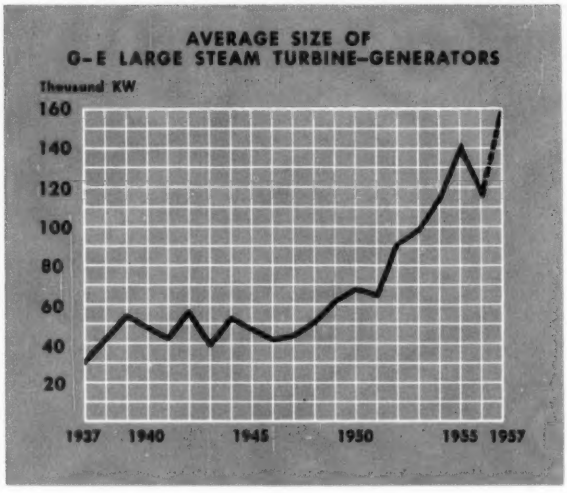
30-ft deep stacking pit accommodates six generator stators at the same time for stacking laminations. Each of the six stations has its own hydraulically operated press.

World's largest adjustable rail milling machine, capable of work equivalent to three 18-ft planers, saves time by allowing work to be set up on one table while machining proceeds on the other. Shown here machining a 225,000-kw generator stator frame, this mammoth unit stands 35-ft high, is 120-ft long and weighs 1,230,000 pounds.

General Electric is helping to meet tomorrow's power demands . . . today

To keep pace with the tremendous design advances of tomorrow's powermakers, new manufacturing techniques are continually being developed, and additional unique production tools are being designed and built. Already, electronic and magnetic tape controls are being applied to increase speed and improve accuracy of some machining processes.

Such forward-thinking investment in new tools and facilities for building large steam turbine-generators gives assurance that General Electric will continue to help the electric utility industry maintain its spectacular record of meeting the nation's constantly expanding power needs. Large Steam Turbine-Generator Department, Schenectady, New York. 254-54



Larger units, ranging up to 450,000 kw in size, are now being designed and built. Historical growth in average size of powermakers shipped from Schenectady is shown here.

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Write for the Keystone butyl story—complete. Over 12 years of field service and tests, with charts and graphs of test results . . . plus 36 pages of technical data to aid in specifying and installing the right cable for the job . . . have gone into Okonite Bulletin PW-463. Write The Okonite Company, Passaic, N. J.

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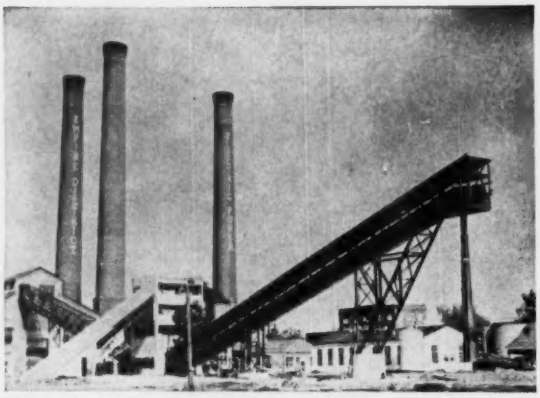
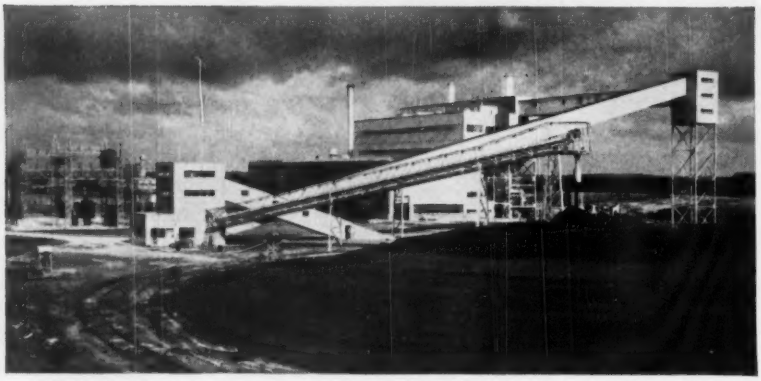


McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.



McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

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Gentlemen: Send more information on your Coal-Handling Systems.

Name_____ **Title**_____

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MARMADUKE

Continued from page 146

by drum-type marine boilers.

"A week before, one of the boilers had been put back on the line after a complete overhaul. Her CO_2 recorder usually showed a 12% reading. After lighting off, the boiler maintained that reading. But around 6 pm the CO_2 suddenly nosedived to 8%. The shift operator checked the boiler's inspection and cleanout doors, but couldn't find anything wrong. Then he thought of comparing readings with the orsat, but it was broken. So he called the chief at his home about 11 pm. Sanchez told him to overhaul the recorder, then hung up.

"An hour later the operator had the recorder back together. He hadn't found anything wrong, and was sure the instrument had been shipshape right along.

"But when he hooked it up, the CO_2 reading again shot back to 12%. So he naturally thought the recorder had been at fault. The following morning the chief was in for a surprise. He found the operator's notes in the log book explaining how he had corrected the reading, but it was again down to 8%.

"The chief and his assistant took turns checking the boiler. Fires, draft, boiler casing—everything that might cause excess air to get into the boiler was given the once-over. But no reason could be found for that bouncing CO_2.

"The chief again could think of only one thing—the recorder. He took it apart himself. But when he had it together and turned on, the reading hadn't budged from 8%.

"This time the chief reported his problem to the president of the lighting company who called his consulting-engineer brother in Caracas, Venezuela. The kid brother took the next boat and showed up a few days later. He brought an orsat and checked the boiler. Readings jibed with the recorder readings. He could't find anything wrong, so said the boiler would have to be cut out so he could inspect it from the inside. But the chief couldn't cut out the boiler just then, nor for at least six weeks.

"'So this crazy thing I'm to do by tomorrow, so his brother can go back on the next boat in three days,' wailed the chief. But just as he said that he saw the young consultant at the bar. The chief called him over and introduced us.

"'My theory,' explained the consultant when I questioned him, 'is that there's a short circuit of air from the register. I think a baffle is loose and shifts back and forth with the slight

With this new round shape, UNITRACE costs substantially less per foot. And since the steam passage has less outside wall area, external radiation heat loss is reduced. The need for thermal insulation is often eliminated. When insulation is used, it costs less because standard pre-formed pipe covering can be used.
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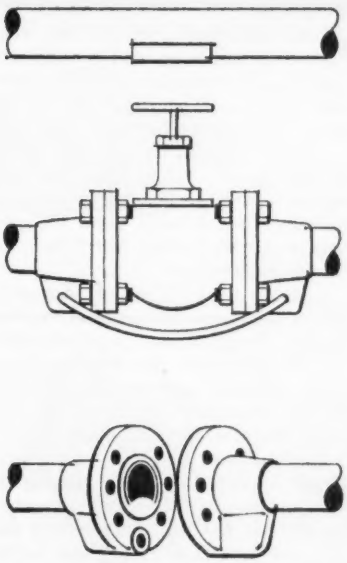
boost efficiency
of steam traced pipe...
ALCOA UNITRACE has a NEW SHAPE
for lower cost per foot...
easier joining...
less heat loss...better
internal heat transfer



Sections of UNITRACE in the new shape can be easily and quickly joined by the weld and patch method (top). And a brand new UNITRACE flange—with product and steam passages cast as integral parts of the flange—simplifies installation of valves (center) and other flanged connections (bottom).

Want to save money on steam-traced piping? Here's good news for your pocketbook! ALCOA® UNITRACE *has a new cost-cutting shape* . . . a round section matching standard pipe shapes . . . available in 1½", 2", 3" and 4" sizes.

With steam and product passages extruded in a single unit of light, strong, corrosion-resistant Alcoa aluminum alloy 3003-F, UNITRACE completely eliminates the cost of external steam jackets or tracer tubes. And the new UNITRACE shape makes possible these *extra* savings:

Lower cost per foot . . . total volume of metal is less; material costs are lower.

Easier, faster joining . . . new configuration (with exterior grooves for quick steam passage identification) makes mating and joining fast and simple to cut installation costs.

Less external heat loss . . . improved internal heat transfer . . . the new design reduces area for external radiation loss.

The natural corrosion resistance of aluminum makes UNITRACE ideal for handling naval stores, molten sulfur, ammonium nitrate solutions, glacial acetic acid, fatty acids, tar, pitch, wax, urea and similar products which normally require heated transfer lines.

Find out today how *you* can use ALCOA UNITRACE to cut costs and improve efficiency of your heated transfer lines. Call your nearest Alcoa sales office, or write Aluminum Company of America, 888-L Alcoa Building, Pittsburgh 19, Pennsylvania.

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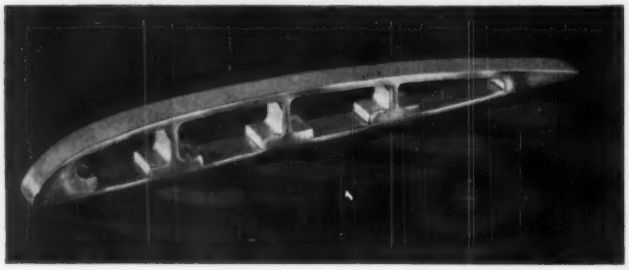

Cross section shows structural superiority of Aeromaster's new, extruded aluminum-alloy blades in diameters from 9′ to 22′.

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AEROMASTER'S new, extruded aluminum blades combine in one design the advantages of a light weight metal, a hollow structure and the superior strength of wrought metal... Silicon-magnesium aluminum alloys resist corrosion. Their fine grain structure, high tensile strength and increased endurance eliminate danger from wear, vibration, and metal fatigue... true airfoil blade sections assure maximum air delivery... adjustable blade pitch angle permits decrease of fan load to an accurate minimum horsepower requirement.

The AEROMASTER fan is easily assembled *in the tower.* No special handling equipment is necessary. AEROMASTER fans cost less to install, less to operate, less to maintain!

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KOPPERS

Aeromaster Fans

Engineered Products Sold with *Service*

*Koppers Trademark

MARMADUKE

Continued from page 210

change in the draft pressure. It was probably disturbed when the boiler was down for repairs.'

"'That wouldn't drop that CO_2 all the way to 8%,' I answered. 'Before you cut out the boiler,' I said to the chief, 'How about bringing me the CO_2 charts taken since that kettle was put back on the line.'

"'What good would that do?' asked the consultant, getting pink around the gills. Guess he didn't like me butting into his business.

"'I'll tell you when I see the charts,' I answered, and let it go at that.

"'Twenty minutes later Sanchez returned. I started with the first chart and glanced at them quickly. Six seconds later I threw them on the table and asked if anyone had the morning newspaper.

"'Sure señor,' piped up the chief, 'you will find our local *Informacion* and the *London Times* on the rack at the end of the bar.'

"A quick look at the last three copies of the local paper and I had my answer.

"'Well, what's the trouble?' asked the chief when I sat down. The consultant just stared at me suspiciously.

"'Can't tell you exactly until I visit that fortuneteller across the street,' I answered, thinking I'd have some fun. Besides, she's the prettiest crystal-ball gazer I've ever seen and I want to get to know her.'

"'Fortuneteller!' yelled the consultant, jumping up and busting out laughing. But the chief only sat there and scowled. 'You make fun of us, Señor Surfaceblow,' he mumbled.

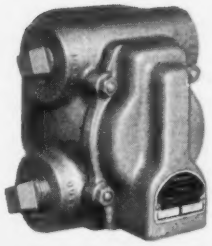
"'Fortuneteller . . . newspapers . . . ha, ha . . . ho, ho,' guffawed the consultant. 'The fortuneteller may be beautiful, but I don't think she can help you with finding that CO_2. No, No, Mr Surfaceblow.'

"'Here's what I'll do,' I suggested. 'If I don't solve this problem at that Madam Teresa Baranca's in one minute, I'll buy steaks and wine for these three señoritas and us—and also for Madam Baranca. If I do, you buy them, Mr Consulting Engineer.'

"That sobered him. 'I'll go you one better,' he yelled suddenly, jumping to his feet again. 'I'll not only accept—but I'll bet $50 you won't correct the CO_2 trouble without cutting that boiler out.' By that time all the customers in the bar had crowded around us.

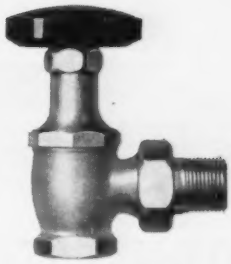
"The chief held our money. Then we navigated across the street to the fortuneteller. But I heard the chief mumbling to himself, 'this is loco, muy crazy, nuts.' (*Continued on page* 214)

STEAM UNIT HEATER VENTS



FLOAT & THERMOSTATIC TRAPS

"Y" STRAINERS



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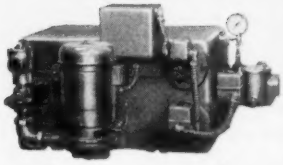
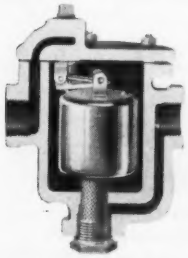


VACUUM PUMPS

PRESSURE REDUCING VALVES



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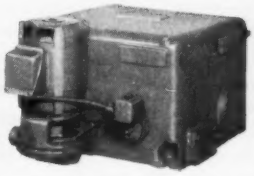
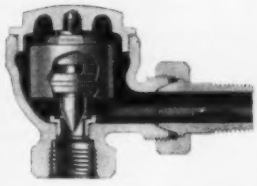


CONDENSATION PUMPS

VACUUM BREAKER



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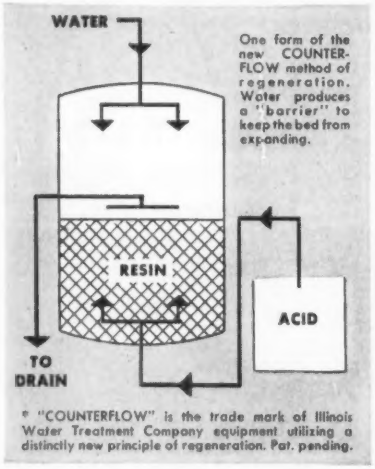

One form of the new COUNTERFLOW method of regeneration. Water produces a "barrier" to keep the bed from expanding.

* "COUNTERFLOW" is the trade mark of Illinois Water Treatment Company equipment utilizing a distinctly new principle of regeneration. Pat. pending.

- Ion leakage is reduced to about 1/3 of the amount common to conventional regeneration techniques.
- There is an increase of approximately 10% in cation resin capacity, with no increase in amount of acid regenerant.
- Removal of organics from the resin is improved.
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- Rinse water requirements are reduced.
- In systems using a two-bed deionizer ahead of a mixed-bed unit, ions can be removed more completely in the more efficiently regenerated two-bed unit, thereby reducing the load on the mixed-bed unit.

Present users of "COUNTERFLOW" are enjoying IMPROVED purity of effluent at LOWER cost of regenerant materials. One power plant, for example, is saving $16,000 a year on acid alone since converting existing de-ionizers to COUNTERFLOW design.

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MARMADUKE

Continued from page 212

"That crystal-ball gazer was a hot number, all right. I wasted no time explaining our visit. I slipped her a dollar before she could say 'no,' threw her robe around my shoulders and put her headgear on my dome. Sanchez and the consultant were plenty skeptical; didn't know whether to laugh or get sore. The three girls just giggled good-naturedly.

"I spread the CO_2 charts around the crystal ball and sat down with the moon shining into the joint over my shoulder. After staring into the ball for a minute, I yelled 'Eureka, I have it . . . look . . . look, that's what's been making your CO_2 bounce like a rubber ball!'

"My friends crowded around — the consultant staring the hardest.

"'Where, where? I don't see anything!' they all said together.

"'Right there,' I said, pointing to the reflection of the moon in the crystal ball. 'It's the moon that's causing all that trouble with your CO_2.'

"'How you figure that?' asked Sanchez disgustedly.

"'Look at these CO_2 charts,' I answered. 'You'll find a pattern. Your readings drop twice each 24 hours, but always about twelve hours apart. Drop is always to 8% and stays there for about two hours. And each day that condition occurs an hour later.' My listeners acted dumbfounded.

"'Knowing my navigation and astronomy,' I continued, 'I can tell you that only the moon can make your CO_2 behave that way. That's exactly the effect it has on the tide also; follows the same pattern. And if you look at the daily tide tables in your newspapers, you'll see your CO_2 readings have been going down with each ebb tide, coming up with each flood tide.'

"'The tide!' echoed the consultant, racking his brain. 'But what's the connection with the boiler's CO_2?'

"'Plenty,' I said, 'Is your boiler near water?'

"'Sure,' he answered, 'Right on the canal, next to the plant.'

"'OK,' I said, 'now we're getting hot. Do you have a cleanout drain line from your boiler floor running into the side of the canal, by any chance?'

"'Sure,' piped up the chief, 'but that 4-inch line has a plug in it. We only remove the plug when the boiler's cut out for cleaning. It's always put back when the boiler is steaming.'

"'You mean it *should* be in,' I answered. 'So when your boiler was down for cleaning last week, the plug was left out. And now every time you

Where's the Trouble?

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Scam sequential annunciator systems provide an audible and flashing visual signal on the first alarm to enable the operator of your control board to determine which point in the monitored process first becomes abnormal . . . successive alarms that develop from the original abnormal condition are indicated by a steady visual signal. You can take proper corrective measures immediately because you *know* where the trouble started.

Shown here is a typical standardized Scam DE-LINE cabinet with integral flasher and reset pushbutton, featuring all the Scam advantages including simple, compact plug-in design.

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USE DETROIT SPREADER STOKERS TO BURN SOLID FUELS WITHOUT EXPENSIVE PREPARATION

DETROIT ROTOGRATE • ROTOSTOKER • ROTOSTOKER (TYPE C-C)

HIGH ECONOMY AND AVAILABILITY • LOW MAINTENANCE

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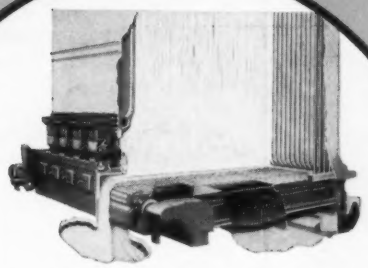

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Original spreader stoker with forward moving grates that discharge the ash at the front. Our long experience has contributed to many exclusive refinements and features of design. Proven superiority with hundreds installed here and abroad. For capacities up to approximately 400,000 pounds of steam per hour.

Detroit Stokers burn any Bituminous Coal or Lignite without special preparation. Commercial sizes ranging from ⅜" x 0" to 1¼" x 0" are ordinarily used. High burning rates without clinkering difficulties. Also many refuse fuels including wet bark, hogged wood, bagasse, etc. are burned separately or in combination with coal; efficiently and without smoke.

Widely fluctuating loads are easily handled. Parasite power is negligible. High overall efficiencies at all capacities are assured. Maximum availability and very low maintenance.

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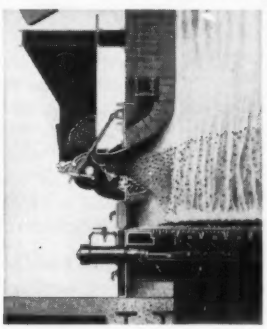
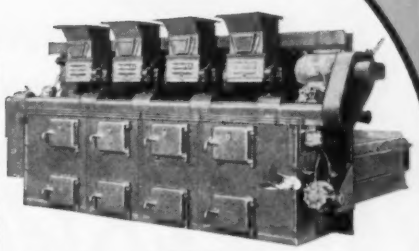


DETROIT ROTOSTOKER

For small and medium size units. Power Dumping, Hand Dumping or Stationary grates to fit the furnace provide desired capacity under full automatic control.

3



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WRITE FOR BULLETINS ON THESE MONEY SAVING STOKERS

MARMADUKE

Continued from page 214

have ebb tide, that line is uncovered, air is drawn into your furnace and your CO_2 nosedives to 8%.'

"'You're right!' yelled the consultant. 'This is the most unusual problem I ever had. I didn't learn anything like this at MIT in the States. Say, Mr Sanchez,' he added as we started across the street. 'Will you run back to the plant and see if you can cover up that hole? Then come back to the Corozol Bar.'

"When the chief returned, he said the plug had been left out. He and the shift engineer threw a few bricks into the furnace, then shoved them over the cleanout drain with long pipes. Then the CO_2 bounced back up to 14%.

"'And to think the moon screwed up the CO_2, just as you said,' commented the consultant. 'It's worth fifty bucks to learn that. Now we all ride out to the Casa Mollendo and celebrate. So girls, we show Mr Surfaceblow our Latin hospitality, eh?'

"The taxi was waiting and we all piled in, with Madam Teresa Baranca squeezed against me. 'Señor Surfaceblow,' she purred into my ear, 'You beeg strong Americano engineero—I theenk my cee-o-too eez going very high. Maybe you tell also my fortune later on—no?'"—*SME*

Marmy's Mailbox

MARMY AND RUBBER

We all follow the adventures of Marmaduke here at Firestone Tire & Rubber Co's powerhouse. Believe me, the old gent not only entertains us, but we all learn a lot of engineering from him. Enclosed is $1.00 for his book.

E F SCHUMACHER JR, *Pottstown, Pa.*

ANOTHER BOOK?

I enjoy reading Marmy. Each story has a sound engineering lesson. How about publishing a second edition of the old consulting-engineer's stories?

D F PARROTT, *Red Lake, Ontario*

LIKES BIG BLAST

"Marmy's big blast," April '57, was superb. Not once did I surmise what the old sea dog was leading up to. Marmy will have to do his hunting in the powerhouse—but that's where he belongs in the first place.

A SWANSON, *Baltimore, Md.*

BOUQUET FOR AUTHOR

Enclosed is $1.00 for book of Marmy's stories. The creator of Marmaduke Surfaceblow must be an astute engineer with a real sense of humor.

L B BARTLETT, *Jacksonville, Fla.*

EDITOR'S NOTE: *Oh yeah?*

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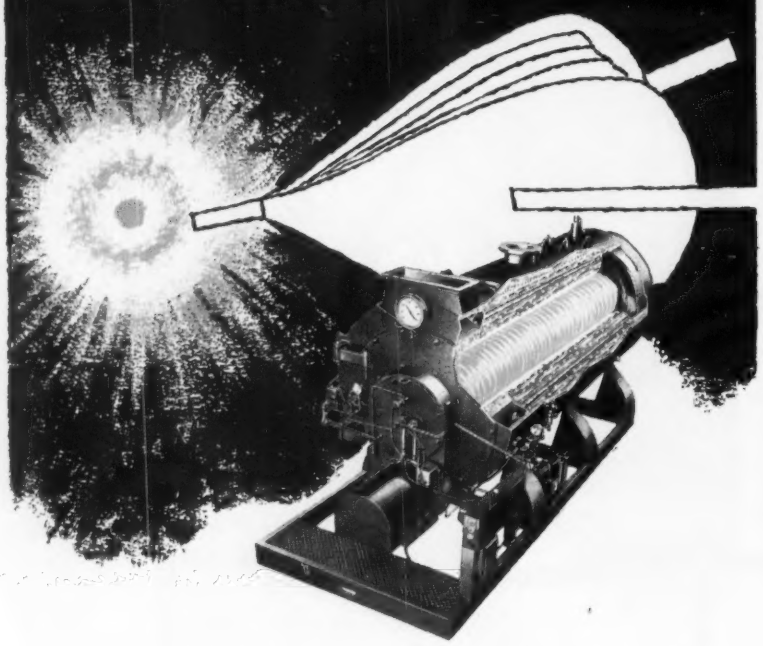
How do you make an ember glow?

Blow on it!



It takes air to promote combustion and when air enters the Cyclotherm combustion chamber at a tangent and with velocity up to 200 mph, really efficient combustion results. The air, assuming cyclonic shape and motion, combines with the fuel to form a flaming vortex spiraling the entire length of the firetube. This Cyclonic Combustion achieves 65% heat transfer efficiency in the firetube alone. An additional 15% is produced in the single pass of return tubes. Cyclotherm guarantees a minimum of 80% efficiency in only two passes.

Cyclotherm also includes an electronic control system for automatic operation. On models up to 60 hp burner automatically shuts off when steam demands are satisfied; resumes when steam is again needed. On larger models, precision modulation automatically regulates firing rate from 30% to 100% without loss of efficiency.

A complete package Steam and Hot Water generator, Cyclotherm is designed, built and assembled by Cyclotherm Division, National-U.S. Radiator Corp., with one manufacturing responsibility behind the entire job. Models 18 to 750 hp; 15 to 200 psi; burns oil and/or gas.

Among additional Cyclotherm advantages are:

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- **No stack—only a simple flue**
- **Maintenance costs cut 30% to 50%**
- **No special foundation needed**
- **A worldwide service organization**
- **Saves one-third the space required by other package boilers.**

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Send me your new booklet "Cyclotherm Cyclonic Combustion"

HEAT ENGINE

Continued from page 93

grams for this cycle. In the T-S charts the sloping constant-P lines for heat absorption and rejection in the cycle show how far it departs from the Carnot cycle with its constant-T heat transfer processes, see Fig. 1. The enclosed area *abcd* on the P-V chart measures the net work output of the cycle; on the T-S chart it shows the net heat converted to work.

For fixed temperature limits we see that the work developed per cycle depends on the pressure ratio. State *d* is the same for all cycles shown in Fig. 4, the other three states vary with the pressure ratio. Fig. 4*c* has a pressure ratio of 2; 4*b* a pressure ratio of 5; and 4*a* a pressure ratio of 9. As the pressure ratio rises through this range the work output rises. But, if we continue raising the pressure ratio as suggested by the dotted cycle *a'b'c'd* in Fig. 4*a*, we see that the work shrinks. Fig. 3 shows that the work output becomes a maximum at a pressure ratio of about 11.

When we study the heat transfer processes in Fig. 4 we see that as the pressure ratio rises, the *average* temperature of the gas rises during heat absorption, and drops during heat rejection. This means that the thermal efficiency of the Joule cycle rises with pressure ratio increase. In fact, at infinite pressure ratio as state *a* approaches and equals state *b*, we have the equivalent of a Carnot cycle which runs at the maximum possible efficiency for the given temperature limits. But, simultaneously, the net area *abcd* approaches zero, see Fig. 4*a*, and the net work output disappears. Fig. 3 shows the variation of thermal efficiency with pressure ratio.

Regenerative Joule cycle. For the lower pressure ratios where the temperature of state *c* is higher than at state *a* we have the opportunity to apply a regenerator and improve the efficiency of the Joule cycle. Fig. 5*a* shows that at state *c* we would apply the regenerator to the cylinder head and reversibly absorb the heat Q_y until the gas temperature dropped to $T_x = T_a$. Then we would remove the regenerator and apply the receiver and reject Q_r.

After the constant-S compression to *a* we again apply the regenerator in Fig. 5*b* and the gas reabsorbs heat Q_y while expanding to state *z* where $T_z = T_c$. We finally apply the source and inject the heat Q_s during the rest of the constant-P expansion. The net enclosed area *abcd* again measures the net heat converted to work and equals $Q_s - Q_r$. Heat Q_y is a constant amount

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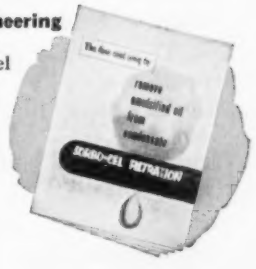

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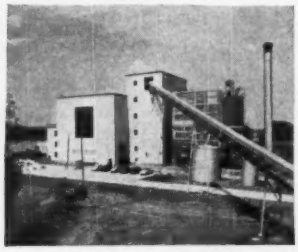

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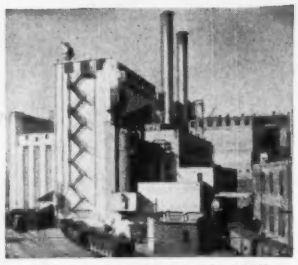
Chamois, Missouri



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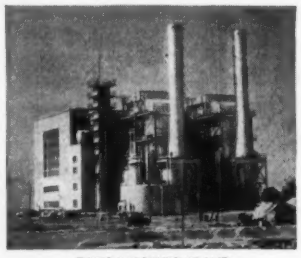

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HEAT ENGINE

Continued from page 218

kept within the engine cycle with the aid of the regenerator.

Here again, note that the regeneration raises the average temperature of the gas during heat input and lowers its average temperature during heat rejection. This makes the temperatures approach the ideal Carnot limits for maximum efficiency. In effect, the regeneration prevents the degradation of some available energy by rejection to the receiver. Any process which prevents such rejection automatically increases cycle efficiency.

Fig. 3 shows how the regenerative Joule cycle thermal efficiency varies with pressure ratio. At zero pressure ratio it equals the Carnot efficiency. It then drops to equal the simple Joule cycle efficiency at the maximum work output per cycle. Beyond this pressure ratio the regenerator cannot be applied because T_a becomes higher than T_c, see Fig. 4.

Next part will cover compressed-air systems for power transmission—in a forthcoming issue.

SOOT BLOWING

Continued from page 86

Another approach is recognizing the need for and providing for soot blowing. Many installations have furnaces designed to allow for more adequate wall-blower coverage, and more blowers are initially installed. This gives more furnace-wall coverage, cuts blowing frequency since slagged areas can be cleaned at alternate intervals, instead of blowing practically continuously on a limited area to compensate for the areas not cleaned at all. It's a welcome relief from the costly process of installing more soot blowers after a boiler has gone into service.

Radiant superheater and reheater use is a third method of attack on the slagging problem. It's an approach significantly different from conventional boiler design and may hold more promise than other methods to date. It means relocating these sections from the convection passes to the furnace itself where considerable radiant heat is available to give needed increase in relative absorption *without* increasing furnace temperatures. Some units use loops hung over the furnace, others use panels in the furnace proper as open dividers or in the wall itself. This results in minimum slagging in the large furnace and deposits are distributed more equally between water-

(*Continued on page* 222)

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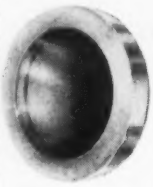

You should use these glasses whenever you work with materials under heat and/or pressure. They withstand high temperatures and sudden changes of temperature, and will remain transparent through a long service life.

PYREX mold finished glasses are recommended for use when pressures are low or low pressures are accompanied by high temperatures.

PYREX annular edge glasses are designed for use on pressure vessels. They will safely withstand pressures up to 450 p.s.i. and temperatures up to 500 F.

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SOOT BLOWING

Continued from page 220

walls and superheater-reheater sections. It improves superheat control range and flexibility because the deposits have less effect on steam temperatures. Soot blowing becomes largely a matter of holding efficient flue-gas temperatures and, in general, promotes a desirable operating condition. One caution: Boiler start-up requires care because the radiant superheater tubes aren't cooled until steam flows through them.

Improved firing methods also should be considered. Present methods, with few exceptions, have changed little since pulverized coal burners were first used. Burner and mill improvements generally haven't kept pace with the increased use of lower quality fuels. If this equipment performs poorly, it's related to the soot-blowing problem in the way that the fuels react in the combustion process.

Finer pulverization and cyclonic firing are two methods that show promise in reducing furnace slagging problems. If a reliable mill can be developed to give a fineness output exceeding 90% through a 200 mesh, it may be used extensively in the future. Such fineness would make more of the particles burn faster, resist agglomeration and stay in the gas stream until they reached cooler temperatures beyond the slagging zone. Cyclonic firing, which eliminates pulverization entirely, allows very little ash carryover into the furnace. In addition to reducing furnace slagging, it considerably reduces the amount of flyash leaving the boiler.

Keep in mind that the only really justified reason for soot blowing is to hold flue-gas temperatures low enough to maintain top unit efficiency. If boiler design improvements ultimately lick the severe slagging problems (and this outlook is favorable), it's possible that soot-blowing requirements may be reduced to an absolute minimum through use of a vernier control of flue-gas temperature as follows:

Flue-gas temperatures normally fluctuate continuously because of load changes, varying ambient air temperatures, deposit build-up between soot-blowing periods, seasoning of heating surfaces and other factors. Though the degree of change is small, it's significant when applied on an overall efficiency basis to a large unit. In addition, as utilities flirt ever-nearer or even below the dew point, unstable gas temperatures may trigger corrosion and plugging in the air heater and flyash equipment.

Many new units are using steam coils to partially preheat the air be-

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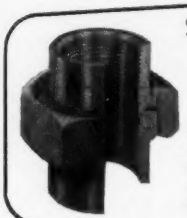

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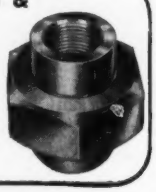

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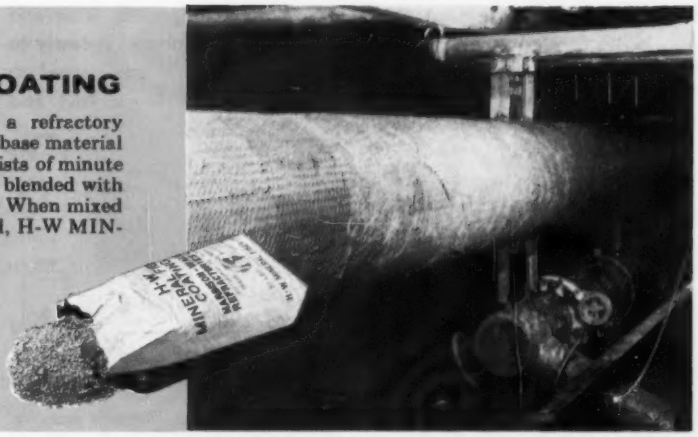
H-W MINERAL FIBER COATING

H-W MINERAL FIBER COATING is a refractory plastic mortar of high insulating value. The base material having the composition of mineral wool consists of minute pellets with multiple closed cells. These are blended with asbestos fiber and a strong adhesive binder. When mixed with water to thick consistency and applied, H-W MINERAL FIBER COATING readily adheres to clean surfaces, hot or cold, rough or smooth, metallic or refractory, vertical or overhead. It is used extensively as a well bonded resilient coating on H-W BLOCK INSULATION and insulating fire brick.



H-W FINISHING CEMENT

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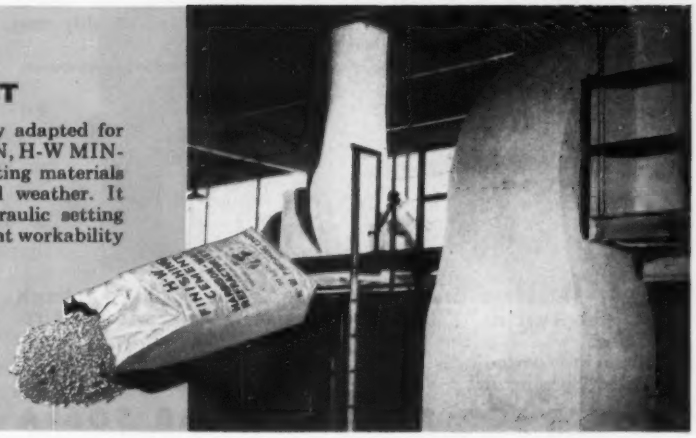

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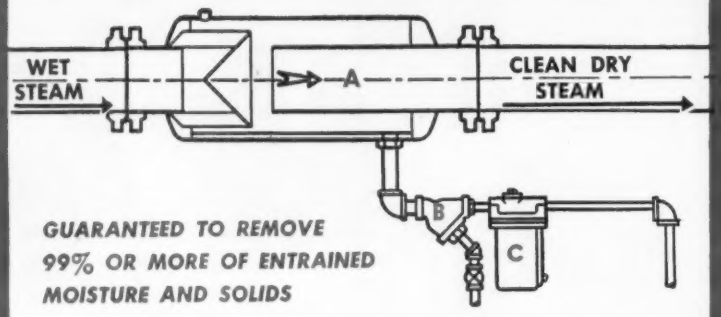

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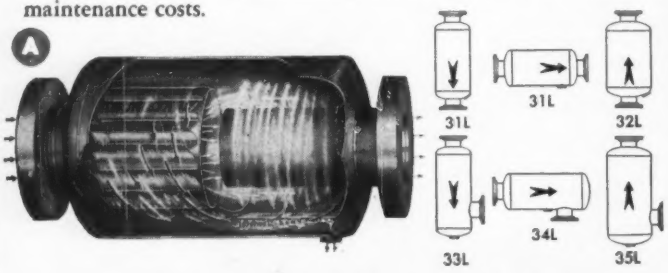
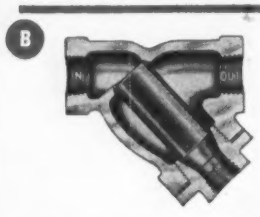
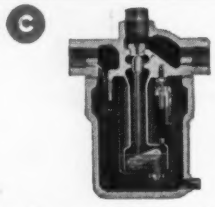
Live steam containing condensate, boiler compound, scale and other foreign matter is detrimental to equipment and is costly to super heat. These Wright-Austin accessories are engineered to give you maximum purification, resulting in lower fuel and maintenance costs.



This Wright Austin separator employs centrifugal force to remove impurities from steam, air or gas flow. The Type 30L. as well as other Models shown, are light weight, compact and sturdily constructed according to the ASME Code.



Foreign matter drains to Wright-Austin "Y" Type strainer which catches solids. These are periodically blown out by opening drain valve.



Condensate flows through strainer to Wright-Austin "Airxpel" Bucket trap. This unit automatically drains condensate as collected.

WRITE FOR NEW CIRCULAR 506-A

WRIGHT-AUSTIN COMPANY

3245 WIGHT STREET • DETROIT 7, MICH.

SOOT BLOWING

Continued from page 222

tween the air heater and the f-d fan. This permits air-heater design for low exit gas temperatures, but acts as a floor to prevent a drop to dangerous levels during very cold weather. Unfortunately, present arrangements aren't in operation during most of the year because of generally conservative air-heater design and omission or limited range of coil air-temperature control.

Increasing coil size, with corresponding decrease in air-heater size, would permit year-round coil operation. It could be supplied by a steam source available for both start-up and full load conditions. It could have a wide control range, intended for continuous operation, heavily loaded during winter and lightly loaded during summer operation. The control could be activated either by gas temperatures, air-heater-metal temperatures, or both.

Economics of this scheme would, of course, have to be justified by the individual plant. Where used, however, the arrangement should give steady, efficient gas temperatures at a minimum level determined by desired operation of air heater or other affected equipment. Coils could automatically compensate for daily and seasonal load changes, ambient temperature change, fuel and combustion characteristics and air-heater sizing. Since boiler gas exit temperatures could fluctuate without affecting air-heater gas exit temperature, more ash buildup could be tolerated with less frequent soot blowing.

Locating soot blowers on a new boiler is a very important matter. It's suggested that more emphasis could be placed on this aspect of boiler design. The empirical factors and relationships which determine soot-blowing requirements should be thoroughly analyzed and expected slag and ash zones pinpointed for required cleaning rather than relying on experience from units which may be only superficially similar.

The fuel's slagging characteristics (sulfur and alkali, percent ash, softening temperatures, etc), as well as furnace heat release, tube spacing and configurations, gas temperatures and velocities should be carefully studied. Graphic layouts of probable cleaning arcs are helpful.

Such an approach early in the plant's design certainly should pay dividends by reducing the usual need to add or relocate soot blowers after the unit is on the line.

Next month's article deals with he soot blower itself. A survey of the latest application problems and a discussion of blowing mediums, maintenance costs and equipment design trends.

NEW YORK'S COLISEUM—

The building that "has everything" has heating and air-conditioning systems of

NATIONAL PIPE

OWNER: Triborough Bridge & Tunnel Authority
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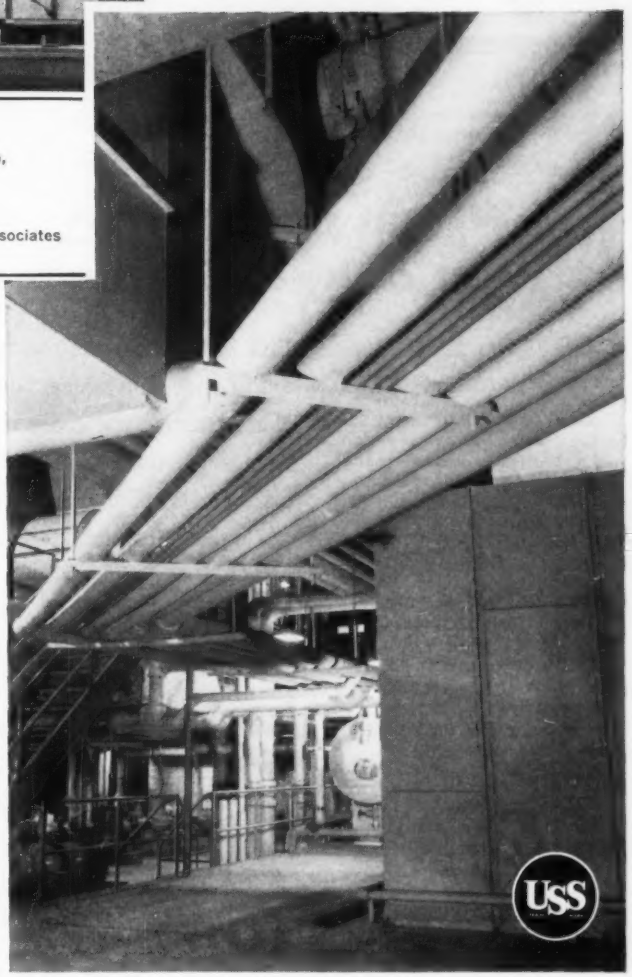
CONSULTING ARCHITECTS: Eggers & Higgins, John B. Peterkin, Aymar Embury III
GENERAL CONTRACTOR: Walsh-Fuller-Slattery
HEATING & AIR CONDITIONING: Almirall & Company, Inc.
MECHANICAL & ELECTRICAL ENGINEERS: Guy B. Panero Associates
STRUCTURAL ENGINEER: Dr. Jacob Feld

New York City's Coliseum is one of the most distinctive and functional structures ever conceived. Its 26 floors and giant exhibition hall comprise an auditorium area capable of seating over 10,000 persons, approximately 1,000,000 sq. ft. of usable floor space, and an 850-car underground garage. Except for the garage, the building is completely air conditioned.

More than 376 tons of National Pipe were used in the heating and air-conditioning systems of the new structure. The office building area requires 1,500 tons of refrigeration; the Coliseum proper requires 2,500 tons. Four compressors supply 4,000 tons of refrigeration for the high-pressure air-conditioning system.

Purchased steam is delivered at 125 to 150 psi. Pressure-reducing rigs reduce it to 50 psi and 5 psi for distribution throughout the buildings. Steam requirements are about 102,000 lbs. per hour for comfort heating and auxiliary uses.

Possessing a solid reputation for dependable service, USS National Pipe is the choice of engineers and contractors throughout the country for air-conditioning, heating and power installations. It is synonymous with efficient, satisfactory service under all types of pressure and temperature conditions. For more complete information, get in touch with us. For technical assistance, our engineering staff is at your service.



NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

NATIONAL PIPE

UNITED STATES STEEL

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DUST COLLECTION SYSTEMS

My biggest boner...

happened to someone else. A plumber called us from 30 miles away. He wanted a 5-hp boiler retubed. Because the boiler was small, I suggested he disconnect it, place it on a truck and bring it to our shop. It would cost much less to retube in our place.

Next morning he arrived with the nest of boiler tubes rolled into their tube sheets. Taking a closer look at the ragged sheet edges, we saw that he had drawn a circle on each tube sheet between the outer tubes and the boiler shell. Then he spent all night with a 3/8-in. portable drill, drilling and chiseling the sheets so he could remove the entire tube bundle from the boiler. He brought in the bundle only, ready for us to cut out the tubes and roll in new ones.

After pinching myself to see if I was dreaming, I finally gasped and said, "But how do you expect us to put those tube sheets back into your boiler if we do roll in new tubes?"

Then it was his turn to gasp. He turned on his heels, jumped into his truck, and we never saw him again. This was 50 years ago—before welding. So don't ask why we couldn't have welded the tube sheets back into place.

Because this boner was so unbelievable, we kept that bundle around our boiler shop for years. If anyone ever pulled a bigger boner, I've yet to hear about it . . . have you?

E H McCATHRON, *Bridgeport, Conn.*

More FREE LITERATURE

Begins on page 167

stainless steel tubing and pipe. Gives permissible variations in OD, ID, wall, ovality and straightness. Peter A Frasse & Co, Inc, 17 Grand St, New York 13, N.Y.

11 **Gate valves,** check valves and fire hydrants are subject of 244-p catalog 57. Illustrated and diagramed, it gives referencing information and specs. Darling Valve & Manufacturing Co, Walnut & Marshall Sts, Williamsport, Pa.

12 **Steam specialties** are described in 60-p catalog 69. Includes steam-trap pressure capacity and size tables, illustrations, dimensions. Strong, Carlisle & Hammond, Strong Steam Specialties Div, 1392 W 3rd St, Cleveland 13, Ohio.

PRIME MOVERS AND ACCESSORIES

13 **Four-cycle in-line engines** are discussed in 16-p illustrated bulletin

Here's Why . . .

You Save With Silicone Insulated Outdoor Motors for Power Stations

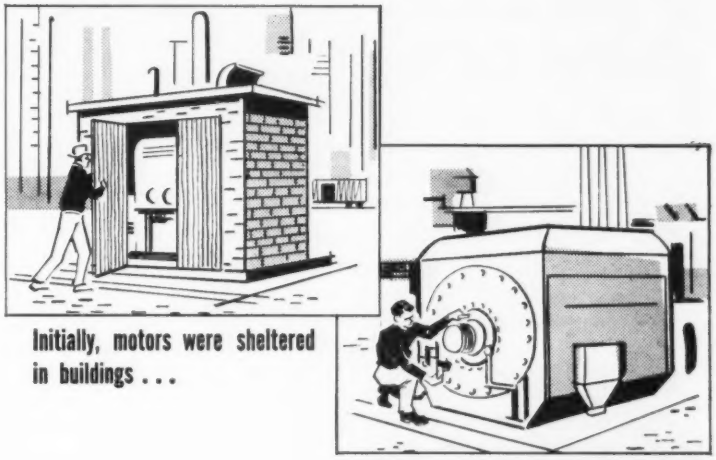
Silicone insulation is establishing a trend toward less costly enclosures for auxiliary drive motors in power stations. By readily withstanding moisture and contaminants circulated in ambient air, Dow Corning silicone insulation makes possible more open enclosures and lower cost per horsepower.

Leading electrical equipment manufacturers already offer complete lines of silicone insulated "all-weather" motors in ratings from 100 to 5000 horsepower.

Safe, reliable operation outdoors the year 'round is assured by Dow Corning silicone insulation. Experience has shown silicone insulated motors readily withstand torrential rains, hurricane winds, corrosive fumes, fly ash, dust, salt air, snow, sleet, cold, heat — even flooding.

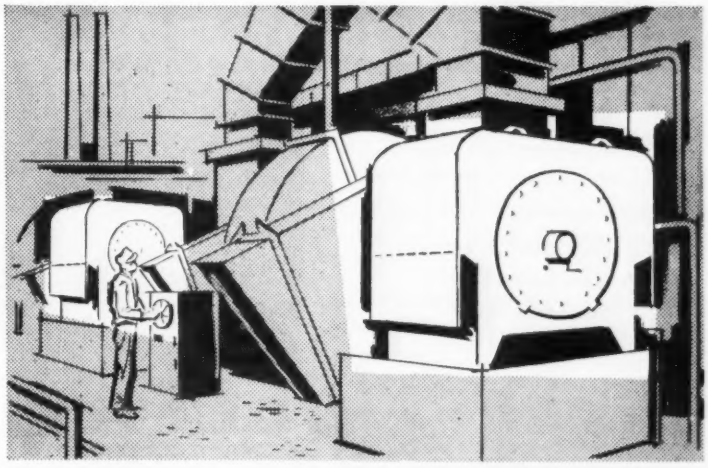
Extra overload capacity is provided by the silicone insulated windings. As a general rule, silicone insulation offers a 50% greater service factor and lasts at least 10 times longer than Class B insulation under similar operating conditions. That's why for the most dependable auxiliary drive motors, it's wise to

Specify DOW CORNING SILICONES and *Save*



Initially, motors were sheltered in buildings . . .

Later, motor enclosures themselves sealed out surrounding atmosphere



Now, silicones protect motor parts permitting the circulation of ambient air . . . lower-cost enclosures.

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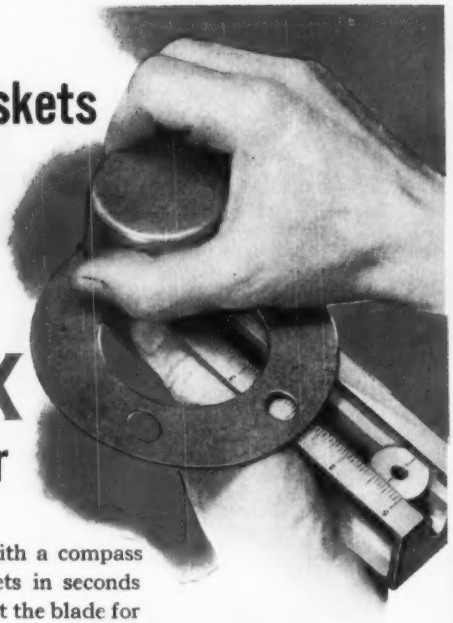

If you can draw circles with a compass you can cut perfect gaskets in seconds with this handy kit. Just set the blade for the desired thickness, set the pivot post at the desired diameter, and a smooth swing of the cutter gives you a clean, accurate gasket . . . from a ¼ inch bolt hole to a 60 inch outside cut. Larger diameters can be cut with additional extension arms.

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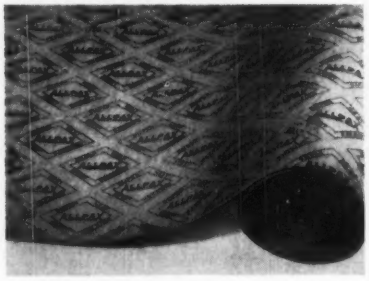

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More FREE LITERATURE

Begins on page 167

257. Separate data sheets give hp ratings, dimensions. Nordberg Manufacturing Co, 3085 S Chase Ave, Milwaukee 1, Wis.

14 **Stationary diesel** is subject of 8-p bulletin 111. Lists typical applications, contains product photos, construction features, specs and performance curves. The White Motor Co, White Diesel Engine Div, 1403 Sheridan Ave, Springfield, Ohio.

15 **Hydraulic turbines** are described in 48-p bulletin 02B7301A. Illustrated with hydro station photos, diagrams. Auxiliaries are included. Allis-Chalmers Manufacturing Co, Box 512, Milwaukee 1, Wis.

PUMPS

16 **Motor-driven pumps,** controlled-volume type, are described in 32-p bulletin 553-1. Contains complete specs, latest design features. Standard and modified models are illustrated. Milton Roy Co, 1300 E Mermaid Lane, Philadelphia 18, Pa.

17 **Reciprocating pumps,** vertical and horizontal are discussed in 8-p illustrated bulletin 9900-A. Includes performance tables, dimensions, construction features, lists of accessories. The Deming Co, 42 Broadway, Salem, Ohio.

18 **Fractional-hp canned pumps** are subject of 8-p illustrated bulletin. Contains diagrams, capacity table, selection information. The Corley Co, Inc, 220 W 42 St, New York 36, N.Y.

19 **Two-stage pumps,** general-purpose centrifugal type, class GT, are listed in 2-color 16-p bulletin 7062-C. Describes performance characteristics, illustrates features. Ingersoll-Rand Co, 11 Broadway, New York 4, N.Y.

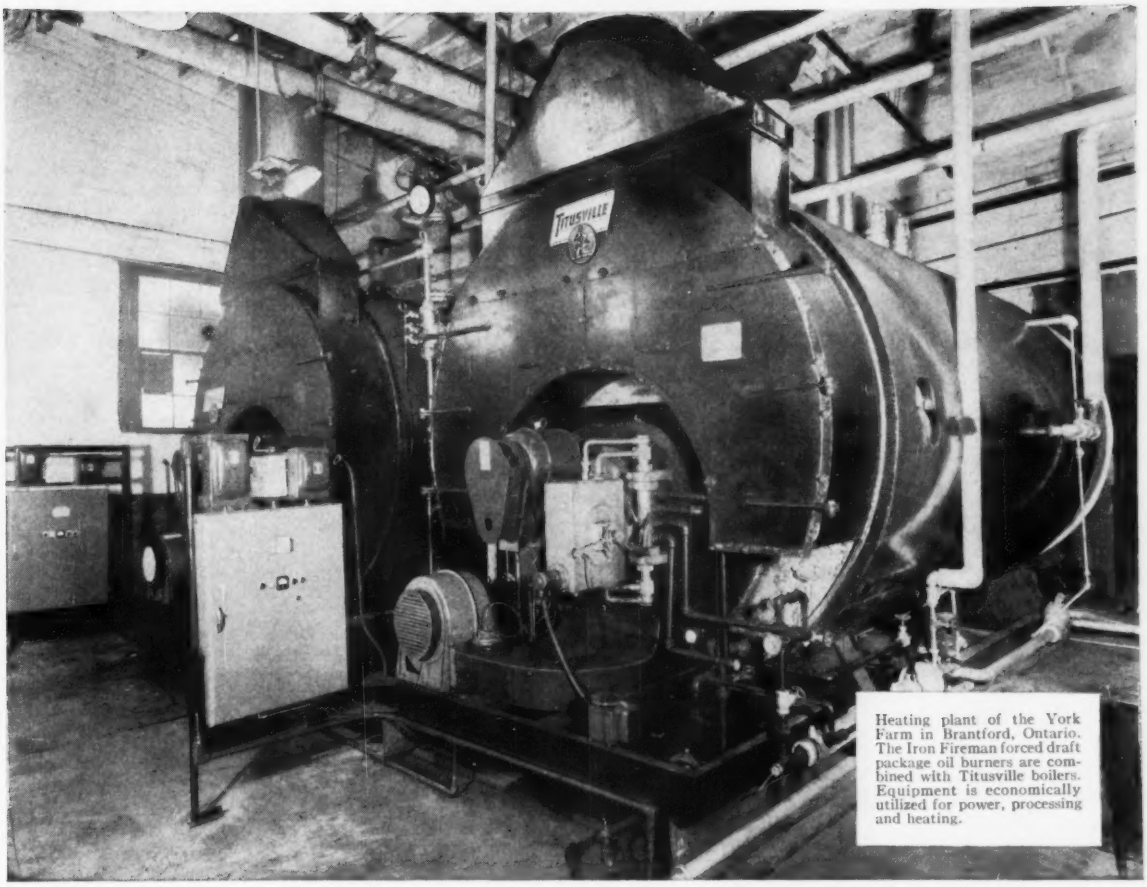
20 **Sand and slurry pumps** for heavy-duty service are described in 4-p illustrated bulletin 601. Includes application information, parts list, capacity chart, dimensional drawing and chart for different size pumps. Krogh Pump & Equipment Co, 515 Harrison St, San Francisco 5, Calif.

WATER TREATMENT

21 **Unusual case of carryover** is subject of 4-p technical paper 136. Points up fact that physical condition of boiler is important when steam conductivity rises. Betz Laboratories, Inc, Gillingham & Worth Sts, Philadelphia 24, Pa.

22 **Water treatment** is subject of 6-p illustrated folder. Lists deionizers, demineralizers, softeners, filters; describes their functions. H M Mueller Corp, 3340 Gorham Ave, Minneapolis 26, Minn.

23 **Water treatment** of wet-type dust collectors is discussed in 2-p bul-



Heating plant of the York Farm in Brantford, Ontario. The Iron Fireman forced draft package oil burners are combined with Titusville boilers. Equipment is economically utilized for power, processing and heating.

These Iron Fireman Package Firing Units Saved the Owner $10,478 in One Year

York Farms in Brantford, Ontario reports that in 1954 fuel costs were $35,650.00. In 1955, after installation of the Iron Fireman forced draft oil burners with matched boilers, the fuel cost was reduced to $25,171.45 . . . a saving of $10,478.55!

Iron Fireman firing system is engineered as a single complete unit. The Iron Fireman "package" burner is a complete combustion system including burner, control panel, forced draft air supply and fuel system, all of which are correctly balanced, integrated, wired and tested at the factory. With Iron Fireman there is no divided responsibility—no locally assembled job with separate estimates and contracts. Rather it means a factory engineered unit which assures dependable performance, high operating efficiency and low fuel cost.

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More FREE LITERATURE

Begins on page 167

letin. Gives case histories. The North American Mogul Products Co, Standard Bldg, Cleveland 13, Ohio.

24 **Chlorinator** with manual or automatic control is described in 8-p illustrated bulletin 25-130. Includes design features, flow diagram, technical data. Wallace & Tiernan Inc, 25 Main St, Belleville 9, N.J.

WELDING

25 **Electrode pocket guide** ADC 650G contains 70 pages, includes consumption calculator in tabular form. Describes electrode color codes and applications, procedure for use in welding. Air Reduction Co, Inc, 150 E 42 St, New York 17, N.Y.

26 **Guide to welding** of stainless steels is 20-p illustrated booklet for the experienced and less-experienced welder. In Q and A form. Acors Corp, 1500 S 50 St, Philadelphia 43, Pa.

27 **Arc welding** with bronze electrodes, filler rod and wire is discussed in 24-p illustrated catalog W-17. Includes welding procedures, typical applications, electrode and filler rod selection chart. Ampco Metal, Inc, 1745 S 38 St, Milwaukee 46, Wis.

28 **Combination welders,** ac and dc types in 300, 400 and 590 amp are subject of 4-p illustrated bulletin. Contains specs and construction details. The Lincoln Electric Co, 22777 St. Clair Ave, Cleveland 17, Ohio.

MATERIALS HANDLING

29 **General service cranes** are described in bulletin 15005-1-57. Tabbed pages help match up capacity — bridge - span. Explains basic factors in buying cranes, illustrates 16 kinds. Manning, Maxwell & Moore Inc, Shaw-Box Crane & Hoist Division, Muskegon, Mich.

30 **Lift trucks,** towing tractors and platform trucks are listed in bulletin BU-450. Pictures basic models, gives specs, load rating chart. Allis-Chalmers Manufacturing Co, Milwaukee 1, Wis.

31 **Delivery system** for bulk gasses is subject of 16 - p illustrated pamphlet ADC 663A. Diagrams show plans for delivery unit parking. Includes related information on control equipment, distribution pipelines. Air Reduction Co, Inc, 150 E 42 St, New York 17, N. Y.

32 **Transmission products** and their uses in elevating and conveying machinery are described in 88-p catalog 914. Drawings, tables cover shaft collars, couplings, clutches, other equipment. Jeffrey Manufacturing Co, Columbus 16, Ohio.

(Continued on page 232)

A NEW O-B VALVE TO LICK YOUR THROTTLING PROBLEMS

O-B Plug Type Valve Seat and Disc
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for close control of steam, water, oil or air

Try this new O-B Plug Type valve where throttling is a problem and watch how it gives long and satisfactory service.

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Seat and disc in this new valve are stainless steel, hardened to 500-plus Brinell. They are so tough that even hard-to-hold steam can be kept under close control. Sand, scale, or other foreign matter is easily crushed between seat and disc without scoring the surfaces when valve is closed.

In addition to tough seating surfaces, this valve has all the features of O-B quality bronze valves—self-leveling disc holder, full length packing that can be renewed when valve is under pressure, and sturdy body construction. A union bonnet provides extra strength at centerpiece joint and makes it easy to dismantle valve.

The O-B Plug Type valve is made in angle and globe types for 150 lbs. WSP and 300 lbs. WOG, or 200 lbs. WSP and 400 lbs. WOG. Seat and disc are renewable.

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The Ridge Tool Company, Elyria, Ohio, U. S. A.

RIDGID Work-Saver Pipe Tools

More FREE LITERATURE

Begins on page 167

33 **Airstream conveyors** are subject of 32-p bulletin 530. Contains detailed technical information, system diagrams, over 70 illustrations. Mr H W Gaeckle, General Sales Manager, Dracco Corp, Box 1794, Cleveland 5, Ohio.

MECHANICAL TRANSMISSION

34 **Bearings,** pillow block-mounted, are described in 8-p bulletin A-668. Contains photos, drawings, tables on dimensions, shaft sizes, weights. Dodge Manufacturing Corp, Mishawaka, Ind.

35 **Shaft-mounted drives** are listed in 8-p selection tables. Higher-ratio units are included. The Falk Corp, Department 255, 3001 W Canal St, Milwaukee 1, Wis.

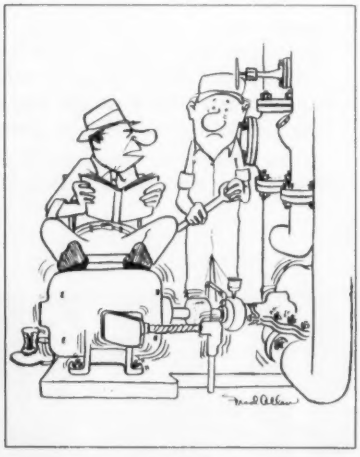
MISCELLANEOUS

36 **Thermal dryers** are described in 20-p color-illustrated bulletin 756. Contains dimension drawings, gas flow diagrams, installation drawings. McNally Pittsburg Manufacturing Corp, Pittsburg, Kan.

37 **Noise control** is subject of 8-p brochure. Applications of mufflers are illustrated with charts, photos. Includes performance data in frequency and attenuation levels in decibels. Inserts show construction, air flow graph. Allied Witan Co, 12500 Bellaire Rd, Cleveland, Ohio.

38 **Recent progress** of steel industry is described in digest of technical papers. Lists 61 reports, articles, talks. U. S. Steel, Public Relations Dept, 71 Broadway, New York 6, N.Y.

39 **Directory of coal mines** and coke ovens located along railroad contains 104 pages, maps and illustrations of facilities. Baltimore and Ohio Railroad Co, Traffic Dept, Baltimore 1, Md.



We'll let it vibrate and run hot. How do you expect me to relax my poor tired feet?

Free China *continued*

timber was available in the area. Nearest supply source was 21 miles away, with roads in bad shape and large-scale trucking non-existant. Engineers came up with a solution: two aerial cableways, 13 sky-line miles long, that spanned rice paddies and 500-ft mountain peaks. Every 164 ft along the cableway, a mechanical bucket carries 830 lb of sand and gravel. Supply line runs 24 hours a day, with a round trip taking 7 hours. Lines carry 1680 buckets.

Purchase of equipment with limited funds was second big problem. China shopped in world markets and bought concrete pumping machines from U.S., steel work, wire rope and generators from Japan, sandblasting machines and sand dryers from Germany.

Availability of labor was no problem —2000 men work three shifts around the clock, earning an average of $25 a month and supplying their own food. Everybody, from deputy-director Tsung-Wen Chen on down, works seven days a week, with two days off per month.

Wan-Ta power station immediately below the dam will have two sets of generators, each with a capacity of 10,000 kw. After leaving the station, water will be channeled to Sun-Moon Lake, 25 miles away, and generate power in another hydro station, making a total increase of 40,000 kw for Formosa's power system.

Advisors sent by International Cooperation Administration are S T Elcock, C L Mutch and George Nielson. ICA advanced $10 million, Taiwan Power Co $3 million. Project is expected to boost island's electric power 10%, aiding 45 new industries.

Russian power savvy amazes U.S. engineers in Moscow

► THE RUSSIANS aren't letting any grass grow under their feet to judge by the reactions of a U.S. delegation of engineers recently returned from Moscow. The 24-man delegation, home after an 11-day meeting of the International Electrotechnical Commission, voiced surprise at Russian advances in electrotechnology and hydroelectric power.

Speaking as leader of the group, Richard C Sogge, of General Electric Co, reported that the Russians are planning a 1000-mile dc transmission line connecting Moscow with power sources in Siberia. In addition, 400-kv power circuits are in operation, he said. U.S. delegates were told that Rus-

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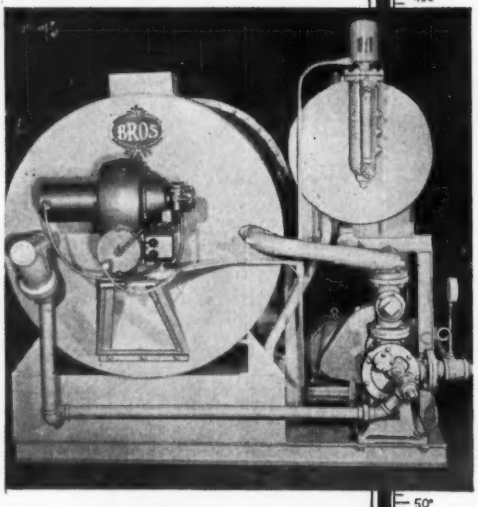
HOW VIKINGS PUMP OIL UP TO 500° HOT



By use of two Vikings, a positive, constant flow of hot oil is pumped through this Bros hot oil heater, providing accurate control of the high temperature—up to 500° F.

Built by Bros Inc., Minneapolis, Minn., the unit is widely used in highway construction, lumber and paper mills, paint plants, soap factories and many other industries.

You, too, will find Vikings ideal pumps for positive and smooth delivery of liquids. For information, write for bulletin 57Sw.

VIKING PUMP COMPANY
Cedar Falls, Iowa, U S A In Canada, it's "*ROTO-KING*" pumps
See Our Catalog in Sweet's Product Design File

REPORTS from the FIELD

Begins on page 152

sia has turbo-generators rated at 150,000 kva in operation and is building them with 200,000 kva.

Delegates noticed that some Russian plant equipment was much older than that in U.S. plants but appeared to be in good running condition. Accident prevention and plant housekeeping were not thought to be as advanced as in U.S. industry.

"We were all surprised," Mr Sogge commented, "that the Communists were so free in showing us installations of real interest to our technical group. Also, we were constantly being asked for criticism of what we saw."

S Davis Hoffman of the American Standards Assn, who was one of the U.S. delegates, reported he was asked to explore the exchange of electrical engineers and technicians between the U.S. and U.S.S.R. This inquiry was made by Nikolai P Galochkin, chief of the department of foreign relations and A Nekrosov, chief of technical department, both of the ministry of power stations—Georgi Malenkov's old stamping ground.

A S Pavlenko, minister of power stations, was chairman of the U.S.S.R. organizing committee and headed up the arrangements for the event. This was one of the first official duties of Mr Pavlenko as successor to the deposed Malenkov.

Delegates from 27 countries, totalling more than 500, attended the annual IEC meeting. Sixteen technical committees were in session during the Moscow meetings.

Reports from the central committee of the IEC, which has headquarters in Geneva, Switzerland, indicate that 16 draft international standards have been received. It is expected that the numerous proposals made by various countries will go into international standards.

These will be considered by technical committees at future IEC meetings.

Survey is advocated for engineering profession

► THE PROBLEMS OF lack of group consciousness and of an accepted code of ethics, confused state registration laws, and lack of genuine legal status were attacked by Dr William F Ryan, president of the ASME, in a recent speech. Dr Ryan advocated a detailed survey of the engineering profession, as proposed by Engineers Joint Council and Engineers Council for Professional Development, which might "enhance the usefulness of engineering to

GAS CLEANING NEWS

Eastern Public Utility Installs Two More Koppers Electrostatic Precipitators to Remove Fly Ash

Major Utility has installed 8 Koppers Electrostatic Precipitators since 1947

YEARS of cost-saving, highly efficient performance preceded this latest installation of Koppers Electrostatic Precipitators. During these years, this leading Eastern public utility was able to judge Koppers by on-the-job operation—the most positive proof of performance.

Proves Performance on the Job

Ten years ago, this company purchased its first two Koppers Electrostatic Precipitators for fly ash removal. Satisfactory performance and low maintenance costs justified the purchase of additional Koppers units that were installed in a total of 4 stations. The eight units furnish highly effective, trouble-free operation in a varying range of CFM capacities.

Supplies a Wide Range

The eight Koppers Electrostatic Precipitators serve boilers ranging in capacity from 570,000 #/hr to 950,000 #/hr. Guaranteed efficiency runs as high as 98%, depending on the need of each application. This ability to engineer for a wide range of capacities enables Koppers to satisfy the needs of each station.

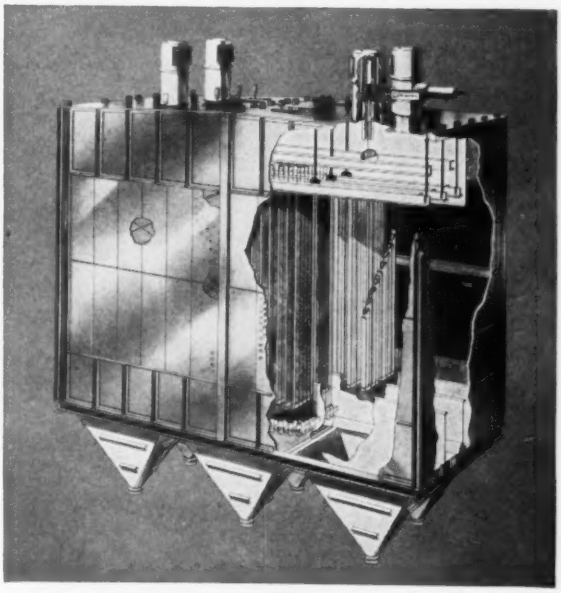
Meets Individual Plant Needs

Koppers custom-designs each Electrostatic Precipitator. Koppers units remove boiler fly ash before the flue gas is discharged from the stack. In designing Electrostatic Precipitators, Koppers utilizes its knowledge of the characteristics of various coals, types of boilers and methods of firing.

Backed by Know-How

Koppers gas cleaning experience goes back 75 years. This experience is backed up by extensive research facilities at Verona, Pa., and Baltimore, Md. From this experience and research has come gas cleaning equipment for all sizes and types of plants.

Get the most out of your gas cleaning dollar. Write KOPPERS COMPANY, INC., Metal Products Division, Industrial Gas Cleaning Dept., 4811 Scott Street, Baltimore 3, Maryland.



This cutaway photo of a Koppers Electrostatic Precipitator shows shell, vibrators, and collecting and discharge electrodes. The actual design and arrangement of elements vary widely because Koppers Electrostatic Precipitators are custom-engineered to fit the requirements of each installation.

Enlarged drawing of Thermalastic insulation tape. High coil voltage can't get through the fish scale barrier of large mica splittings. The patented *elastic* impregnant expands and contracts with the coil to prevent tape separation; that's the *big difference* between Thermalastic insulation and other types.

Here's why Thermalastic insulation ends major cause of generator and motor failure

LARGE mica splittings have long been recognized as the most reliable coil insulation material, but for years it seemed impossible to find the RIGHT impregnant for the insulation tape.

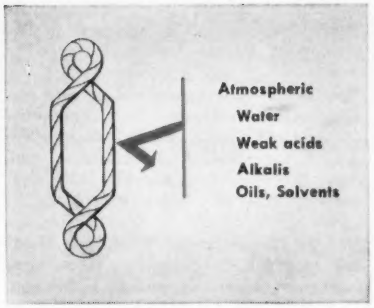
Some were too brittle and others too plastic at high coil temperatures; none could withstand repeated expansion and contraction of the coil . . . and sooner or later, tape separation caused failures.

Then the great discovery — In 1949, Westinghouse research scientists made *Thermalastic*® insulation a reality by discovering the "miracle resins" which cure to a *tough* resilient solid. Large mica splittings, overlapped like fish scales, are locked in this elastic bond which "breathes" . . . expands and contracts with the coil. It doesn't harden or soften with repeated heating by the coil. It doesn't deteriorate with age.

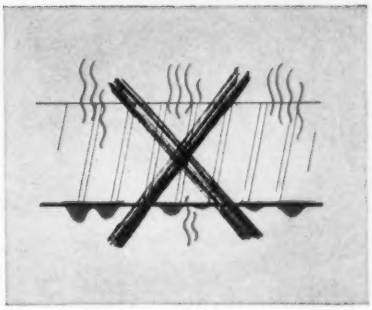
New color movie and bulletin show how and why Thermalastic insulation has extended the life of more than 40 million kva of generators and large motors. Contact your Westinghouse representative or write to Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-15004

YOU CAN BE SURE...IF IT'S

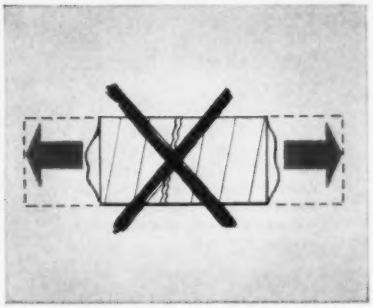
Westinghouse



Withstands attacks
which weaken and finally destroy other insulations. The Thermalastic insulation bond is void-free, has great density, and it's chemically inert. The physical strength of the resilient insulation wall is far greater than that of ordinary insulations.



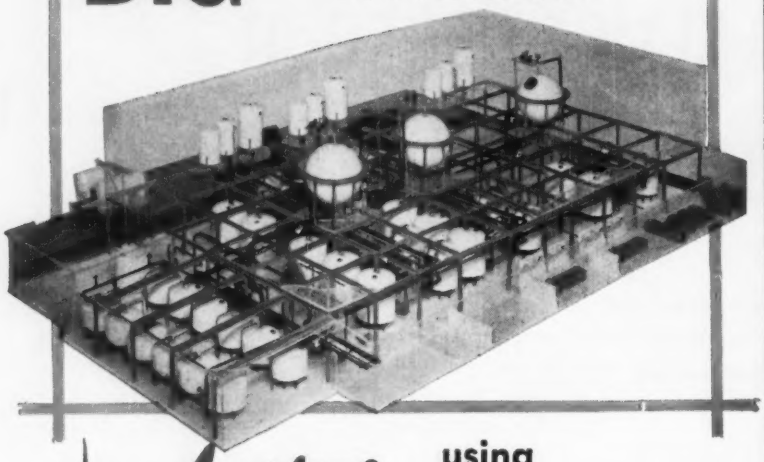
Doesn't soften or embrittle
The patented resins in Thermalastic insulation are thermosetting . . . heat changes them from a liquid to a permanently elastic solid which doesn't soften or embrittle after repeated heating. And it doesn't deteriorate while in storage or in use.



Not stressed
The insulated coil is heated to operating temperature, and *while it's expanded,* the resins cure to an ELASTIC solid. That's why Thermalastic insulation is relaxed when the coil expands, compressed when it contracts. It flexes when the coil is overloaded.

Model of

BIG DEMINERALIZER EFFICIENCY



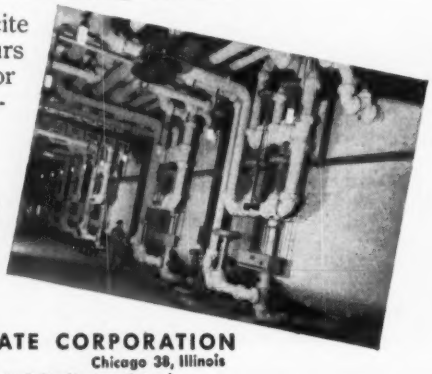
Nalcite® (DOWEX*) using ION EXCHANGE RESINS

BUILDING and operating a giant demineralization plant, like the one shown in model form above, are most impressive achievements. Unseen, yet vital, are the materials for which the whole plant is designed: the ion exchange materials used.

In this demineralizer, as in many other installations, Nalcite Ion Exchange Resins do the job efficiently . . . with both high capacity performance and outstanding resistance to attrition losses.

Whether your demineralization needs call for a pint an hour or thousands of gallons per minute—make sure the chemicals that do the job are Nalcite Ion Exchange Resins.

Technical data on Nalcite Ion Exchangers are yours for the asking. Write for this valuable information today.



The model grows up. Section of demineralizer plant modeled above—one of world's largest—showing some of automatic control features.

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Nalco PRODUCTS

When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.

REPORTS from the FIELD

Begins on page 152

the national economy and to mankind."

A similar survey made of the medical profession 50 years ago is credited with leading medicine to its present status. Dr Ryan noted that many people, including engineers themselves, cannot define an engneer or his job. Only a handful of engineers, he stated, bother about helping to further the professional aspects of their job, and less than one-half of all practicing engineers belong to any engineering society.

A chart of present-day engineering organization, Dr Ryan said, "would be a good organization for a rabbit warren inhabited exclusively by two-headed rabbits." One aim of the survey, according to Dr Ryan, would be to "find out who is an engineer and what he does" and to "undertake to let him do it."

Calendar of Events

Nov 4-6—American Institute of Electrical Engineers, Ninth Annual Machine Tool Conference. Hotel Schroeder, Milwaukee, Wis. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Nov 12-14—National Association of Corrosion Engineers, Northeast Regional Meeting. Penn Sheraton Hotel, Pittsburgh, Pa. Details from NACE, 1061 M&M Bldg, Houston, Texas.

Nov 13-16—National Association of Corrosion Engineers, short course. Key Biscayne Hotel, Key Biscayne, Fla. Details from NACE, 1061 M&M Bldg, Houston, Texas.

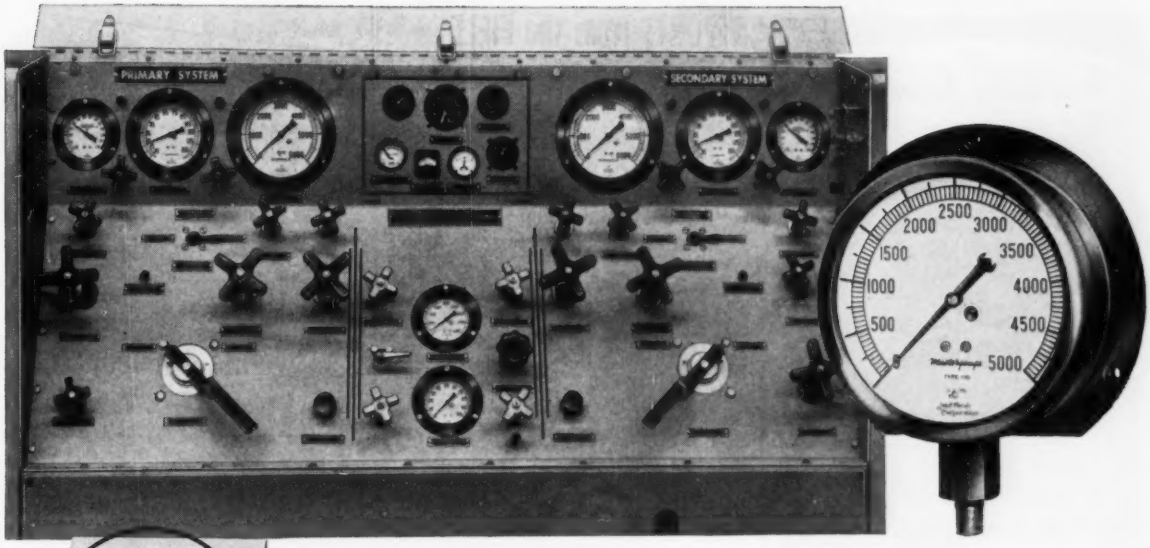
Nov 14-16—American Society of Refrigerating Engineers, semi-annual meeting. Shoreland Hotel, Chicago, Ill. Details from ARI, 1346 Connecticut Ave, NW, Washington 6, D.C.

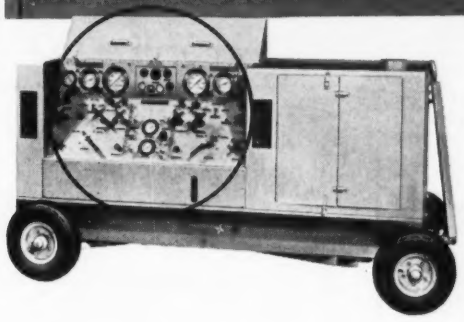
Nov 18-21—Air Conditioning and Refrigeration Institute, 10th Exposition of Air Conditioning and Refrigeration Industry. International Amphitheatre, Chicago, Ill. Details from the ARI, 1346 Connecticut Ave, NW, Washington 6, D.C.

Nov 18-22—National Warm Air Heating and Air Conditioning Assn, committee meetings and annual convention. Morrison Hotel, Chicago, Ill. Details from ARI, 1346 Connecticut Ave, NW, Washington, D.C.

Nov 19-21—Investment Casting Institute, annual fall meeting. Sheraton Hotel, Chicago. Details from the Institute, 27 E Monroe St, Chicago 3, Ill.

Dec 1-6—American Society of Mechanical Engineers, annual meeting,



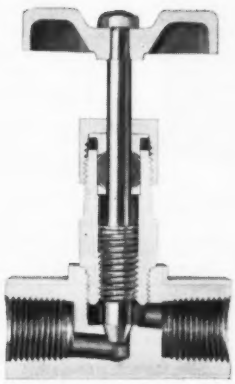


There is no more critical assignment for a pressure gauge!*

Illustrated above is a "close-up" of the instrument panel of one of Sun Electric's mobile Aircraft Hydraulic Systems Testers. The tough task of this unit is to test two jet aircraft at one time . . . to test them under particularly rugged conditions: temperatures from minus 65° F to plus 130°; altitudes up to 6000 ft.; extreme humidity.

It is therefore extremely significant that Sun Electric has equipped this tester with eight Marsh Pressure Gauges and nine Marsh Needle Throttling Valves. Obviously a test is no more conclusive than the instruments which sit in judgment . . . so there is no more exacting duty than this for pressure gauges and needle valves.*

Throughout industry—wherever the emphasis is on real accuracy, lasting accuracy—you will find Marsh instruments. In the Marsh Mastergauge, for instance, all the elements that contribute to gauge accuracy and stamina have been brought to a higher plane. There is the exclusive one-piece, leak-proof construction of socket, tube and tip by the Marsh "Conoweld" process . . . the sturdy "Marshalloy" Case, copper clad inside and outside . . . the precision movement with finer "coined" sector gear . . . the stainless steel tubes and sockets (where needed) for corrosion service . . . the famous Marsh "Recalibrator" to keep the gauge always accurate.



*. . . or for a needle valve

Guaranteed for working pressures up to 10,000 psi, and giving a smooth throttling on any lower pressure, the Marsh Needle Valve is another logical choice for the Sun Tester. The undeviating precision of Marsh Instruments has "rubbed off" on the Marsh Needle Valve to make it the finest in its field. Ask for catalog.

MARSH INSTRUMENT CO. *Sales Affiliate of Jas. P. Marsh Corp.,* **Dept. F, Skokie, Ill.**
Marsh Instrument & Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta
Houston Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Texas

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REPORTS from the FIELD

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Statler and Sheraton-McAlpin Hotels, New York. Details from ASME, 29 W 39th St, New York, N.Y.

Dec 2-6—26th Exposition of Chemical Industries. Coliseum, New York City. Details from Publicity Dept, 26th Exposition of Chemical Industries, 480 Lexington Ave, New York 17, N.Y.

Dec 9-13—American Institute of Electrical Engineers, 1957 Eastern Joint Computer Conference and Exhibit. Sheraton Park Hotel, Washington, D.C. Details from AIEE, 33 W 39th St, New York 18, N.Y.

Dec 9-13—National Association of Corrosion Engineers, in conjunction with University of Illinois biennial Short Course on Cathodic Protection. Details from NACE, 1061 M&M Bldg, Houston 2, Texas.

Jan 27-29—American Society of Heating and Air-Conditioning Engineers, Inc, annual meeting. Pittsburgh, Pa. Details from ASHAE, 62 Worth St, New York, N. Y.

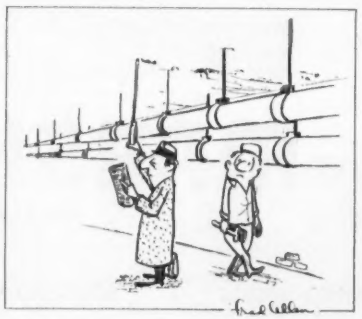
400-lb nerve center will power first jet airliner

► AN ELECTRICAL POWER and nerve center, believed by Westinghouse engineers to be the most advanced and reliable type yet developed, will be an integral part of America's first jet airliner when the Boeing 707 goes into commercial service early in 1959.

The entire system, which could produce enough power to supply the needs of 160 homes, will weigh only about 400 lb, according to officials at Westinghouse.

Initial orders awarded to Westinghouse amount to $1½ million.

Four air-cooled brushless generators —first of that type developed for the aircraft industry—will supply power to operate pumps, blowers, lights, air conditioning, food warmers, radar, radio and other equipment for the comfort and safety of the 707's passengers.



HANDBOOK OF RIGGING

New 2nd Edition. Just published. Condensed into this one book are all the tips, methods, and techniques essential to more effective rigging practices in industrial and construction operations. Deals with everyday maintenance operations — with the transportation and handling of heavy machinery—with the erection and demolition of smaller size structures. Covers everything from ropes, hoisting chains and hooks, to slings and ladders. **By W. E. Rossnagel, Safety Eng'r. 2nd Ed., 342 pp., over 300 illus., $6.50**

PIPING HANDBOOK

Gives you a vast compilation of data and methods for the most effective use of piping . . . principles that influence the design, construction, and use of piping systems. Covers steam power-plant piping, building heating systems, plumbing systems, refrigeration piping, hydraulic power transmission piping, refinery piping, and many others. Revised Fourth Edition features data on formulas for pipe wall thicknesses, gas and air piping, and allowable stresses. **By S. Crocker, Mech. Eng'r., Ebasco Services, Inc. Revised Fourth Edition, 1376 pp., 763 illus., $12.00**

POWER PLANT MANAGEMENT

Practical guide makes plain the techniques management men need to run a power plant smoothly and efficiently to put out dependable power at lowest practical cost. Covers wide range of topics, from purchasing and use of equipment, and safe and efficient operation, to hiring, training, and supervision of operators. Shows how to correlate and weigh objectives, costs, and equipment characteristics. **By R. H. Emerick, Consulting Mech. Eng., 339 pp., 74 illus., $10.00**

INDUSTRIAL POWER SYSTEMS HANDBOOK

Compiled by a staff of experts at General Electric, this comprehensive reference book explains up-to-date industrial power system engineering practices for engineers, technicians, plant managers, and all concerned with the planning and maintenance of electrical facilities for industrial plants or commercial buildings. Gives a wealth of examples and includes a wide range of design data, largely from the experience of General Electric, presented in a simple, practical manner. **By Donald L. Beeman, Mgr., Ind. Power Sec., General Electric Co. 830 pp., 516 illus., $12.50**

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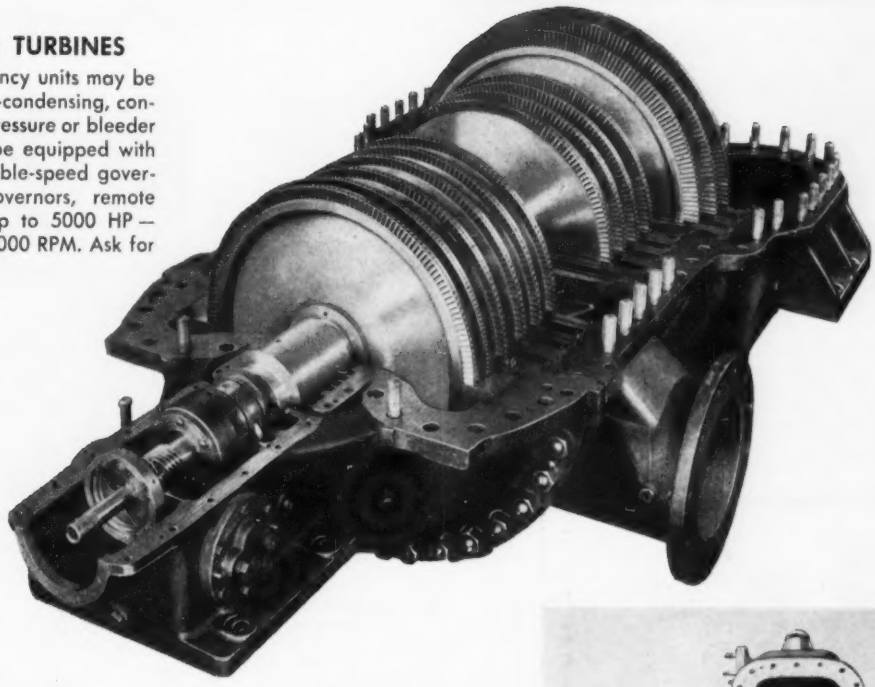
MULTI-STAGE TURBINES

These high-efficiency units may be designed for non-condensing, condensing, mixed pressure or bleeder operation. Can be equipped with constant or variable-speed governors, special governors, remote controls. Sizes up to 5000 HP — Speeds up to 10,000 RPM. Ask for Bulletin S-146.



There's a **Terry turbine** for every mechanical-drive requirement

The designs for Terry turbines are based on more than 50 years of successful experience in the manufacture of turbine drives *exclusively*. This specialization has resulted in Terry becoming one of *the leading producers* of mechanical-drive turbines in sizes up to 5,000 horsepower.

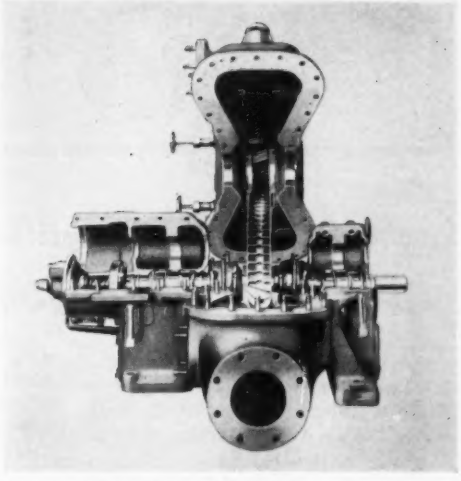
There are three basic reasons why Terry has been able to maintain this position of leadership: (1) a thorough knowledge of the requirements of mechanical-drive turbines, (2) a willingness to build "a little something extra" into each machine to assure trouble-free operation, and (3) an acknowledgement of the company's responsibility to stand behind the performance of every turbine sold.

These are also the reasons why you should consider a Terry turbine for your next mechanical drive. In the meantime, send for bulletins describing any of the types of machines illustrated.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

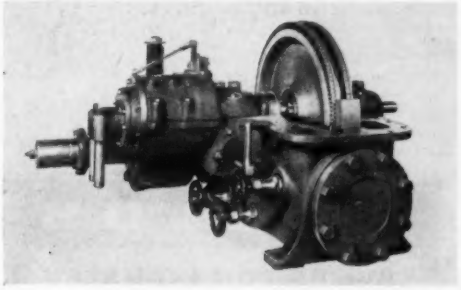
TERRY

TT-1209



SOLID-WHEEL TURBINES

Famous for sure dependability and ease of inspection. Can be started cold — no preliminary warming required. Available in vertical designs depending on frame size. Capacities from 5 to 2,000 HP. Described in Bulletin S-116.



AXIAL-FLOW IMPULSE TURBINES

Built with one, two or three rows of high-grade stainless steel blading, these turbines combine efficiency with durability. Available in designs for moderate and high steam pressure. Bulletin S-143.

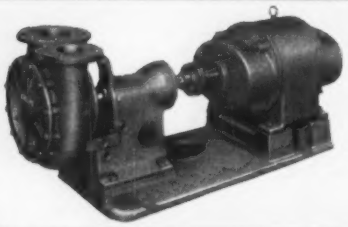
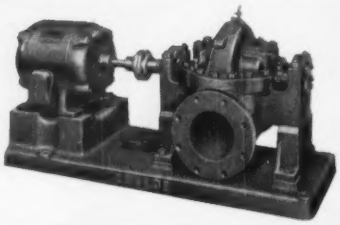


Fig. 3715 single-stage, side-suction centrifugal pump with capacities to 800 GPM and heads to 300 ft. In 10 sizes from ¾" to 3". Temperatures to 350°F. Send for Bulletin 725.4.

Fig. 3405 single-stage, double-suction centrifugal pump with capacities to 6400 GPM and heads to 425 ft. In 33 sizes from 3" to 12". Temperatures to 350°F. Request Bulletin 721.6.



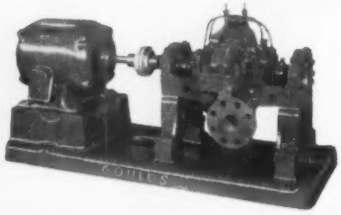


Fig. 3305 two-stage, opposed-impeller centrifugal pump with capacities to 1200 GPM and heads to 1000 ft. In 8 sizes from 1 ½" to 4". Temperatures to 350°F. Described in Bulletin 722.6.

How to keep salt water from chewing holes in your pump budget

Does salt water give your pump ulcers?

You can stave off this costly damage with a pump alloy that's both tough and hard — Nickel-Aluminum-Bronze (Goulds No. 1121).

Your pumps will resist abrasion, too, if they're Goulds pumps built with this new alloy. Toughness and hardness in Goulds 1121 Bronze (Nickel-Aluminum-Bronze) combine to give a high degree of resistance to abrasion, excellent resistance to failure from attack by sand, salts, slurries, and cavitation erosion. Here's how this special material performs:

1. Resists salt water pitting better than chromium stainless steels by 3 to 1.
2. Withstands cavitation erosion better than 18-8 steels by 2 to 1.
3. Holds down salt water corrosion better than standard manganese bronze by 12 to 1.

You can get this extra protection against destructive salt water—in the three pumps shown above. Just specify the fluid end in Goulds 1121 Bronze.

To meet other tough corrosive conditions, choose any of these pumps in Gould-A-Loy 20, 316 stainless, leaded bronze, all iron, or bronze fitted. No matter which one you choose, you'll get quick delivery from factory stock.

If you want more specific information on any of these pumps, send for the bulletins listed in the illustration.

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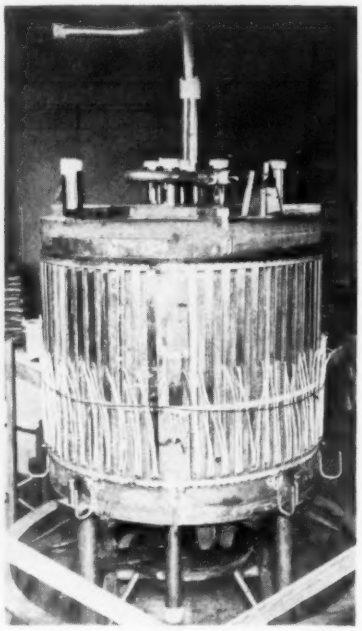
REPORTS from the FIELD

Begins on page 152



► PICTURED ABOVE is the aircraft reactor core of the airplane reactor experiment at Oak Ridge National Laboratory, which Union Carbide Nuclear Co, division of Union Carbide Corp, operates for AEC.

Reactor stands about 36 in. high and is slightly more than 33 in. in diameter. The large tube at top is an outlet for the sodium heat exchanger unit, while the smaller extensions represent two fission chambers (at outer rim) and four regulating-control rods.

Dr A M Weinberg, director of the laboratory, indicated that the reactor had been designed to operate at 1500 kw; it actually ran at a peak output of 2500 kw. Reactor first became critical on Nov 3, 1954 by adding on enriched uranium tetrafluoride concentrate to the barren mixture of molten fluoride salts and was brought to full power operation on Nov 9, 1954.

Temperature of fuel entering the reactor was 1200 F and climbed to about 1500 F before leaving the core. At these temperatures, reactor glowed red. Unit ran continuously for about four days and nights and logged more than 90-mw hours of high-power, high-temperature operation before it was shut down and dismantled.

Bonn (McGraw-Hill World News)— Vereinigte Kesselwerke Ag., Dusseldorf, and Foster Wheeler Corp, N.Y.C., have agreed to co-operate in development on nuclear reactors. This was the first such U.S.-German agreement.

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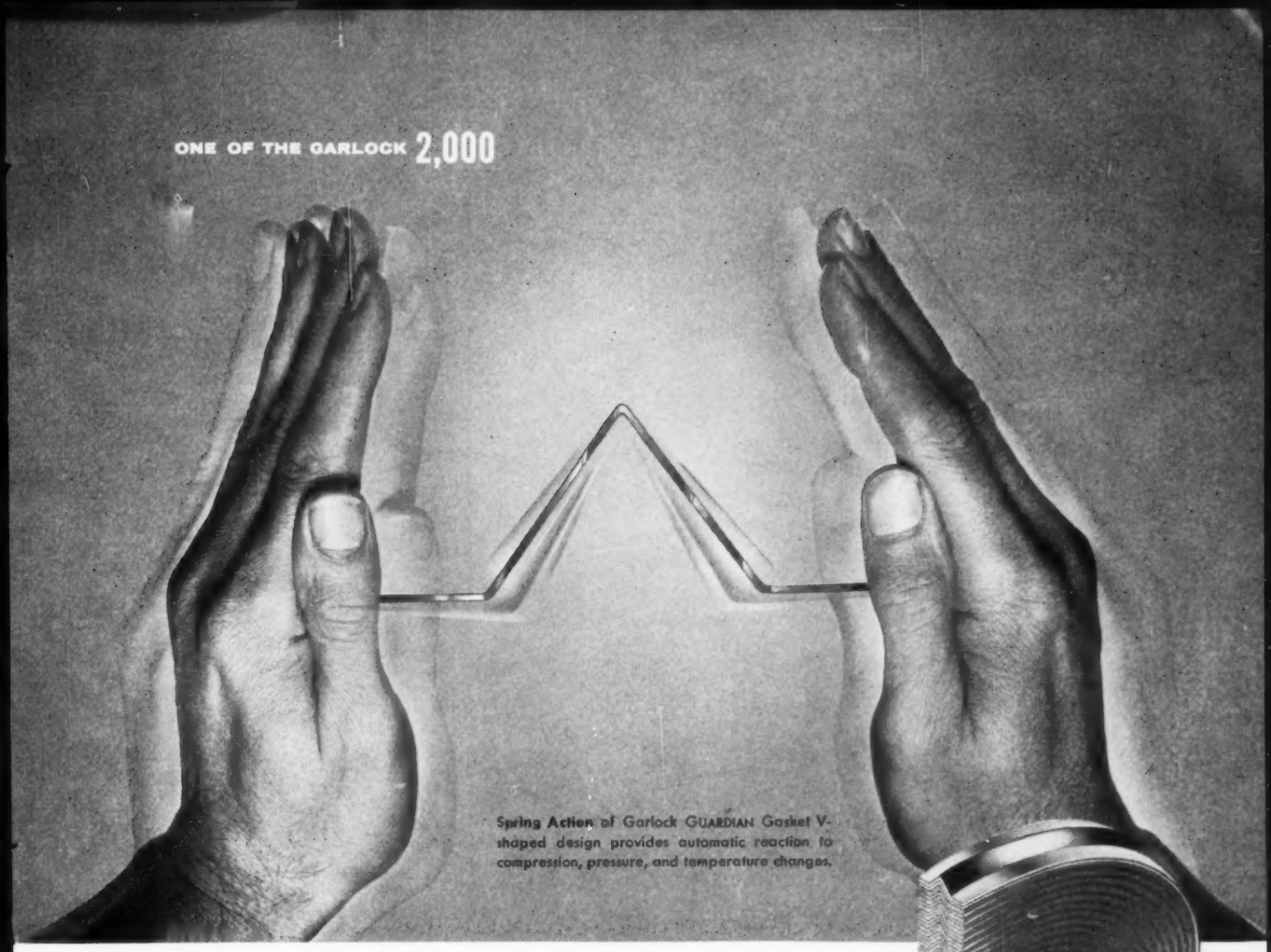

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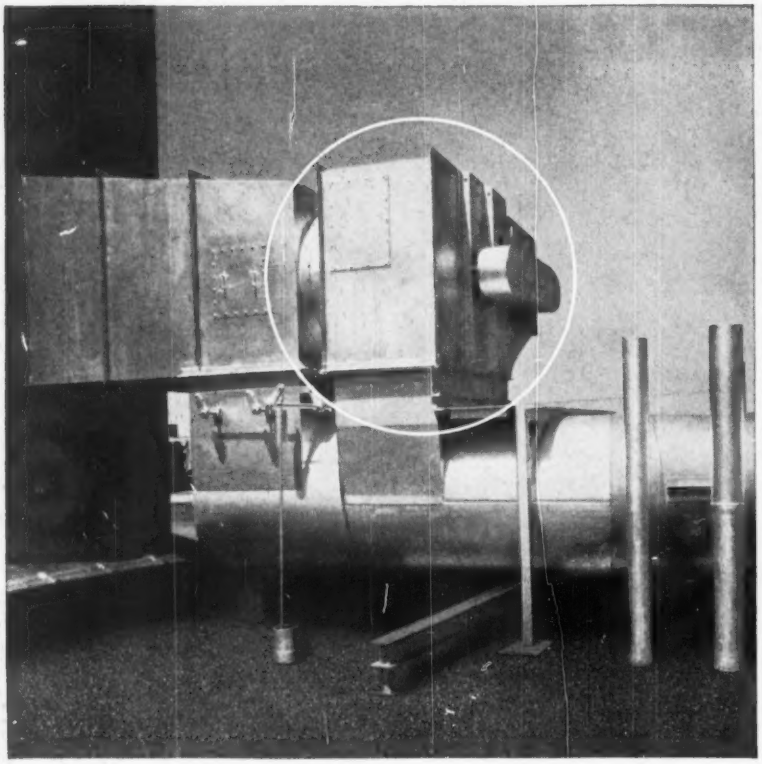

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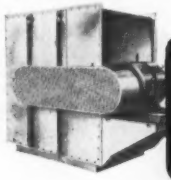

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BOOKSHELF

Reactor Handbook: Physics. *Prepared by the U.S. Atomic Energy Commission—contributors: Argonne National Laboratory, Battelle Memorial Institute, Brookhaven National Laboratory, Knolls Atomic Power Laboratory, North American Aviation, Inc, Nuclear Development Associates, Oak Ridge National Laboratory, Vitro Corporation of America. 10½ x 8, 790 pp, illust, tables, $12.00. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

One of a 6-volume set that contains research and engineering methods and data on the uses of atomic energy. This book covers reactor physics and radiation shielding. The first section discusses theoretical and experimental techniques used in designing and evaluating various experimental and research reactors. The second section catalogues experimental and calculated solutions for various shielding problems and develops methods of tailoring these systems to solutions of new problems.

Chapter headings for the two sections are: REACTOR PHYSICS: Experimental methods; nuclear physics; kinetic theory of neutrons; reactor statics, theory and general results; reactor statics, experimental and numerical results; reactor dynamics. RADIATION SHIELDING: Sources of radiation, permissible levels of radiation, gamma-ray attenuation, neutron attenuation, geometry, ducts through shields, heat generation in shields, shielded optimization with respect to weight, shield materials.

Reactor Shielding Design Manual. *Sponsored by the U.S. Atomic Energy Commission, edited by Theodore Rockwell III, Division of reactor development, USAEC. 10½ x 8, 481 pp, illust, tables. $6.00. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

Engineering methods, showing how to design practical reactor shields, are largely based on methods and data used for naval reactors and the PWR. Data is arranged in the order needed for developing a shield design. The book deals with basic processes, determining allowable radiation levels, shielding the reactor core and cooling system, shield engineering, effect of irregularities in the shield, and geometry of the radiation source. Account is taken of the influence of plant layout, structure and maintenance on design.

The methods discussed form a basic approach compared to the mock-up approach. This should avoid the expensive and time-consuming need of reactor facilities to test full-scale shielding mock-ups.

Handbook of Rigging. (Second Edition), *By W E Rossnage, Safety Engineer, Consolidated Edison Co of N. Y. 6 x 9, 344 pages, illust. $6.50. McGraw-Hill Book Co, 330 W 42nd St, N. Y.*

Book shows how to handle every step in any rigging operation—from rigging a swinging scaffold and painting a steel

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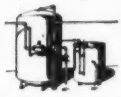

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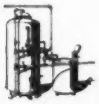

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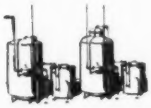

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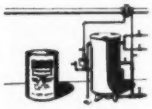

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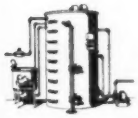

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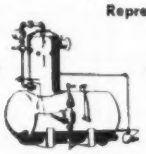

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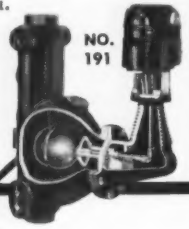

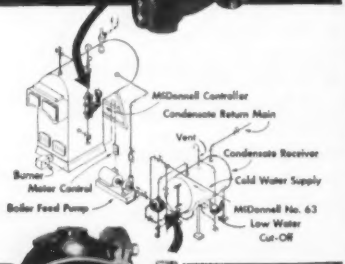

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More BOOKSHELF

Begins on page 244

stack, to operating a hoist or using a hydraulic jack.

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Book has information on methods of loading heavy equipment and attaching sling to loads. New types of scaffolds, overland trains for heavy loads through deserts, swamps, jungles are discussed.

Maintenance Engineering Handbook. *By L C Morrow. Prepared by staff of specialists. 6 x 9, 1528 pp, illust. $20.00. McGraw-Hill Book Co, 330 W 42nd St, N. Y.*

This new book shows plant engineers, maintenance executives, and company managers how to increase profits through better maintenance. More than 75 experts offer techniques, methods, and procedures to keep production at maximum levels, to control production costs and losses, and to prolong the productive life of plant and related equipment.

Information ranges from organization and administration of maintenance forces to practical details of maintaining buildings and service equipment, sanitation and housekeeping, and corrosion control.

Book is planned to give reader a practical insight into the management as well as operative phases of maintenance work—principles of organization, operator and supervisor training, rating and evaluating maintenance jobs, standard times for maintenance jobs, and cost control.

Most of book is made up of information relative to selection, installation and upkeep of kinds of equipment and services that every plant must deal with: electrical, mechanical, and service equipment, transportation equipment, maintenance stores, instruments and welding.

Maintenance of production equipment covers design and construction of bearings, clutches, chains, drives, gears, valves and piping.

Editor L C Morrow is Director of Special Editorial Services of McGraw-Hill Book Co. He is consulting editor and former chief editor of *Factory Management and Maintenance*, also chairman of National Plant Maintenance and Engineering Conferences.

Elements of Machine Design. *By E Rosenthal, technical drawing department, Brooklyn Technical High School and G P Bischof, chairman, technical subjects department, East New York Vocational High School. 6¼ x 9¼, 233 pp, 143 illust, tables. $4.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

This book meets the needs of students in technical institutes, high schools and trade schools. The book starts with a survey of metals used in industry. It then covers problems in applied mechanics, power transmission, and design stresses

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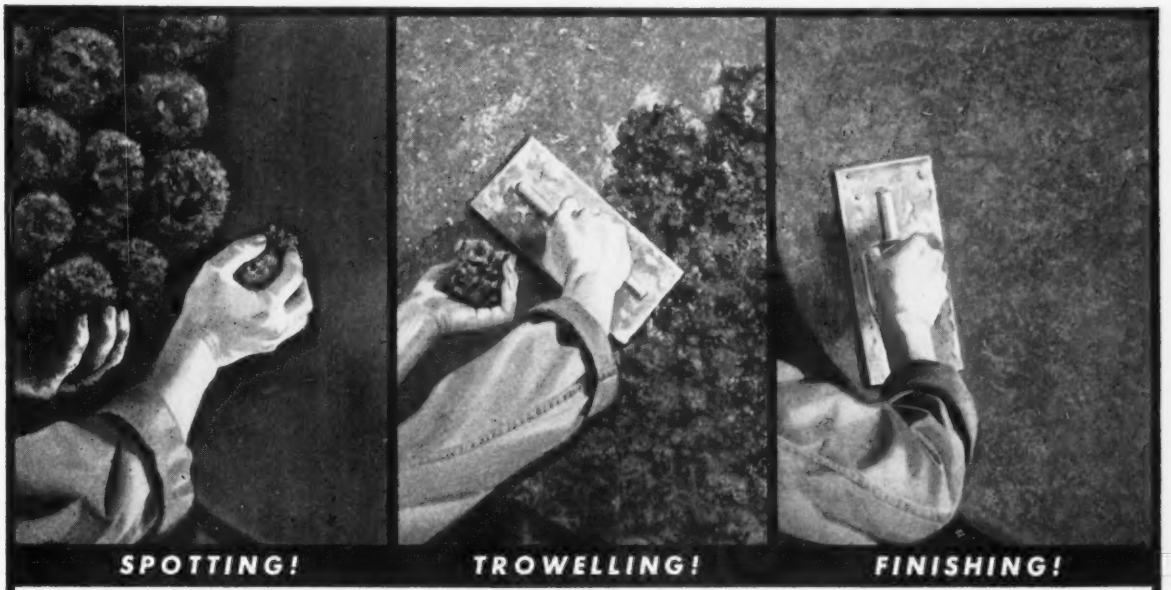

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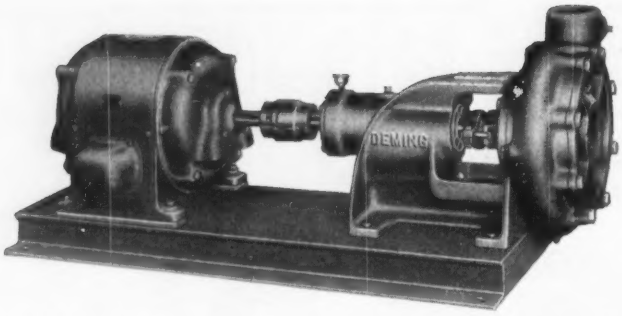

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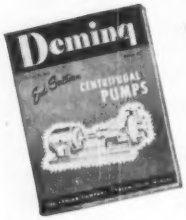

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DEMING
INDUSTRIAL PUMPS

More BOOKSHELF

Begins on page 244

for dynamic loadings. Much of the book discusses the design of principal machine parts—shafts, keys, gears, couplings, bearings, pulleys, clutches and springs.

The authors favor the problem approach to the theoretical approach. As to be expected, higher mathematics than simple algebra are not used in the text.

Elements of Engineering Thermodynamics. *By R H Sabersky, associate professor of mechanical engineering, California Institute of Technology. 6¼ x 9¼, 307 pp, illust, tables, charts. $7.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

Designed as a text for a first course in thermodynamics, the basic principles are developed in fairly simple fashion. The book features an introduction to compressible flow that is more extensive than usual for a book this brief.

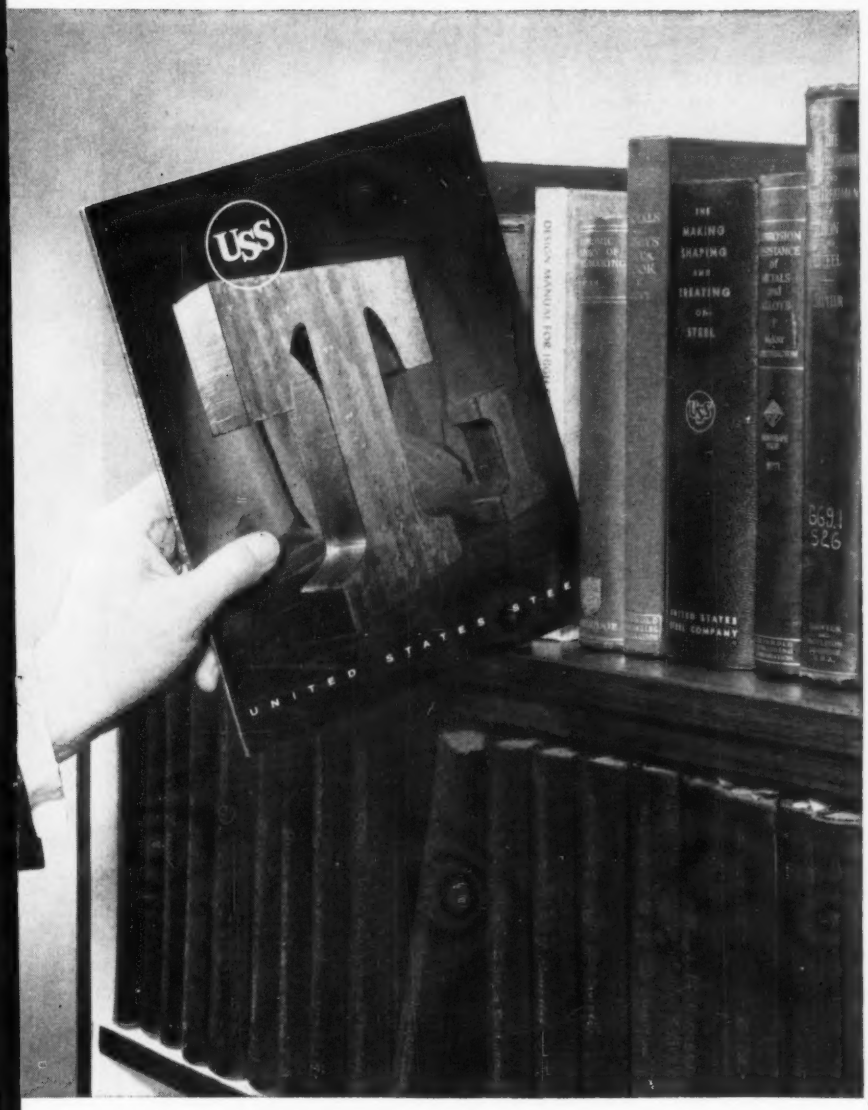
Chapter headings give some idea of the book's scope: Zeroth law and concept of temperature; dimensions and units; definitions and terminology; first law; special processes of a simple system; system in motion; second law; corollaries of the second law; availability; properties of a perfect gas; properties of a general substance; Van der Waals gas; cycles using gas as a working substance; cycles using condensible fluids; jet-propulsion cycles; flow of a compressible fluid; simple flow-measuring devices; special phenomena in compressible flow; flow through a nozzle; elements of turbine design; elements of combustion.

Progress in Nuclear Energy—Series IV—Vol I—Technology and Engineering. *Edited by R Hurst, Harwell and S McLain, Argonne. 9¼ x 6¾, 420 pp, illust, tables, $12.00. McGraw-Hill Book Co, 330 West 42nd St, New York 36, N. Y.*

Another in the "Progress in Nuclear Energy Series," this book gives information on coolants, moderators, heat transfer and chemistry as affected by radiation fluxes of a reactor. The book includes surveys of heavy water production processes, and production and properties of graphite used in reactors. Three short papers discuss beryllia as a moderator. Liquid metals are discussed as coolants and for the special handling problems they pose.

Engineering section of the book covers pumping of liquid metals, coolant pumps, boiling heat transfer, compressed gas heat transfer, molten metal heat transfer, liquid metal heat transfer, heat transfer between uranium and aluminum surfaces, deformations in rod and canning of high flux reactors. Largest section of the book covers reactor chemistry and corrosion with papers on radiolytic behavior of water in a nuclear reactor, PWR water chemistry, homogeneous reactor chemical problems, aqueous uranium and thorium slurries, corrosion of aluminum, corrosion of zirconium and its alloys, corrosion by liquid metals and metallurgical studies on liquid bismuth and bismuth alloys for reactor fuels or coolants.

Speaking of technical bibles...



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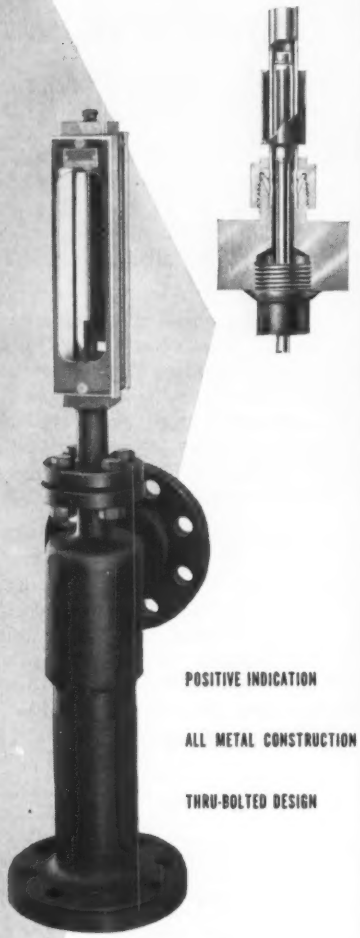

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APPOINTMENTS

Corporation executive changes

Lyon Metal Products, Inc: L D Deal, president; A W Walen, secretary-treasurer. **Great Northern Oil Co:** Arthur W Winter, controller. **Graybar Electric Co, Inc:** John Reine, vice-president. **American Brake Shoe Co:** William C Denison, vice-president. **Mid-Century Instrumatic Corp:** Robert K Stern, president. **Worcester Polytechnic Institute:** Dr T W Van Arsdale, Jr, executive vice-president.

Operations executive changes

Graybar Electric Co: operating managers: K H Coyner, Norfolk; E H Helms, Asheville; F D Masten, Durham. **Westinghouse Electric Corp:** Fred E Everett, manager of marine and transportation section. **Dresser Industries, Inc,** Turbodrill Div: Madden T Works, operations manager. **American Brake Shoe Co,** Manganese Steel Div: W Frank Kelly, vice-president of operations. **National Research Corp,** NRC Equipment Corp Div: H A Steinherz, manager of engineering and development. **United Engineers & Constructors Inc:** Gerald H Brown, vice-president and construction manager. **Reliance Electric & Engineering Co:** branch managers: John P Landis, Appleton; Merle K Sieber, Charleston, W. Va.; Clayton Y Goss, Dayton; Norwood F Joy, Bangor, Me.

Engineer changes

Burroughs Corp, ElectroData Div: Arthur R Marshall, engineering supervisor. **Beckman Instruments, Inc,** Systems Div: Lawrence R Keenen, eastern regional engineering manager. **Crouse-Hinds Co:** Russel P Northup, vice-president for engineering. **National Research Corp:** John S Light, director of mechanical engineering dept. **The Griscom-Russel Co:** Arvid Nihlen, manufacture engineer. **Philips Electronics, Inc:** William R Kiley, applications engineer. **H K Porter Co, Inc,** Leschen Wire Rope Div: Godfrey J Stier, industrial engineer. **International Nickel Co, Inc,** Development & Research Div: Kelvin Sproule, research engineer.

New representatives

For **H K Porter Co, Inc:** Leschen Wire Rope Div: Charles C Wallace, Washington region. For **Cornell-Dubilier Electric Corp:** Frank Abbett & Walter Hustis, 16A Eaton Sq, Needham 92, Mass. For **Lord Manufacturing Co,** Special Products Div: Paul E Dochety, Akron, Ohio; James Brennan, Jersey City, N. J.

For **Bohn Aluminum & Brass**

EXPANSION JOINTS FOR VOLATILES AND GASES

Flexible metal hose, for leak-proof security, inherent static protection. Specially designed Titepak flange for holding high pressures for interlocked type of tubing. Pressures to 200 PSI. 2″ to 24″ I.D. in galvanized steel, stainless steel and bronze . . . with asbestos or special packing lined pressure carrier. Write for booklet to Pennsylvania Flexible Metallic Tubing Company, Inc., 7237 Powers Lane, Phila. 42.

GET YOUR COPY

PENFLEX
TIGHT AS A PIPE BUT...
FLEXIBLE

at U.S. AIR FORCE'S

ARNOLD ENGINEERING DEVELOPMENT CENTER

Tullahoma, Tenn.

Master Control Room keeps close tab on all operations.

LimiTorque MOTORIZED VALVE OPERATION

. . . is helping to assure American Air Supremacy

We are proud that our LimiTorque Controls are used on many of the Valves to provide automatic selective control over many of the vital operations in this great research and development center of the U. S. Air Force. Here they make the weather that races like a cyclone through jet engines in the Engine Test Facility . . . Secondary Spray Banks force 31,800 gpm of cooling water into scorching 3500° F. exhaust on ramjets and turbojets through Crane 10" and 12", 125 pound Globe Valves, which are automatically controlled from the Master Control Room (shown above)—The jet-flame passes through a primary and secondary cooler, where 125,000 gallons of water per minute are sprayed through it, before it is exhausted into atmosphere.

The direction, scheduling and planning of this great AEDC project is done by personnel of the U. S. Air Force. Management, operation and maintenance of the Center, is by ARO, Inc., under contract to the U. S. Air Force. U. S. Army Engineer District, Tullahoma, supervises construction.

LimiTorque Motorized Valve Controls met the requirements for this great project because of their accuracy of operation and absolute dependability.

Send for Catalog L-550, which fully describes and illustrates LimiTorque.

LimiTorque®

PHILADELPHIA GEAR WORKS, INC.
ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.
Offices in all Principal Cities

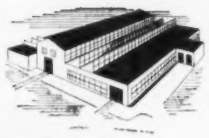
INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

Limitorque Corporation • Philadelphia

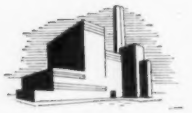
Control enclosures and panels

fabricated by

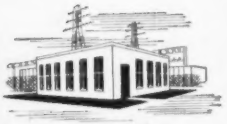
KIRK and BLUM



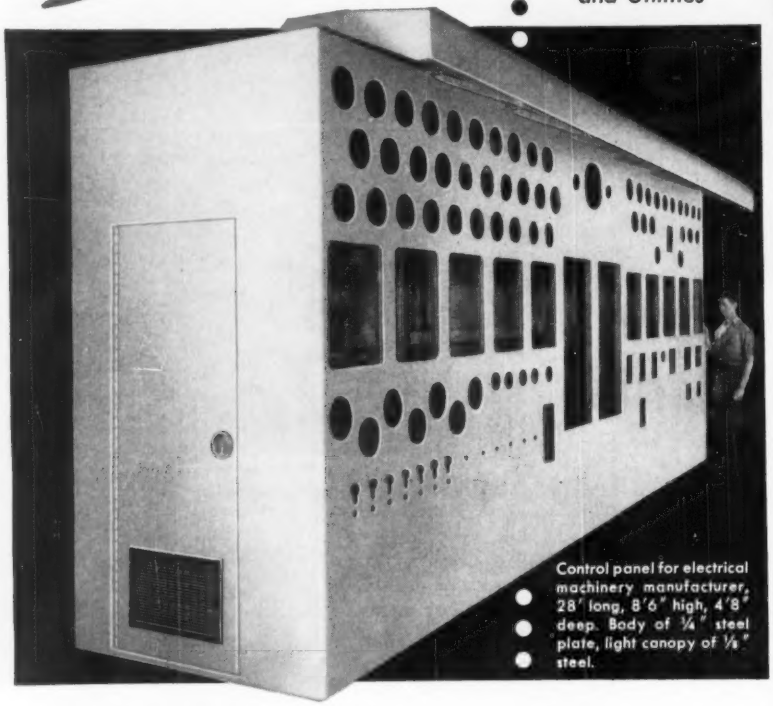
For Industry



Power Plants



and Utilities



Control panel for electrical machinery manufacturer; 28′ long, 8′6″ high, 4′8″ deep. Body of ¼″ steel plate, light canopy of ⅛″ steel.

- CONTROL DESKS and PANELS
- SWITCH GEAR HOUSINGS
- CUBICLES
- TRANSFORMER HOUSINGS and TANKS
- ELECTRICAL ENCLOSURES
- TEST STANDS
- VENTILATING LOUVRES
- INSTRUMENT PANELS

Whether you require panels for 1 or 100 instruments . . . Kirk & Blum is equipped to fabricate them to your most exacting specifications. We offer exceptional experience and facilities for fabricating parts and assemblies of sheet steel, light plate, stainless, aluminum, monel and other alloys in gauges to ½″.

Write for your copy of the latest KIRK & BLUM Electrical Enclosures Booklet. For prompt quotation, send your prints to The KIRK & BLUM Mfg. Co., 3233 Forrer St., Cincinnati 9, O.

KIRK & BLUM

METAL FABRICATION

More APPOINTMENTS

Begins on page 250

Corp, Betz Div: Northwest Factors, Seattle, Wash.; Portland, Ore. For **McGraw-Edison Co,** Pennsylvania Transformer Div: Roy E Coulson, Arizona. For **Goulton Industries, Inc:** Schaal Associates, Inc, 4 Waltham St, Lexington, Mass.; Winfield Electronic Sales Co, 740 N E 147 St, N Miami, Fla.; Edward C Carlson, 6677 N Northwest Highway, Chicago, Ill.; Engineering Services Co, 618 George Washington Blvd, Wichita, Kan.; Metalclean Equipment Co, 177 Stoneway Lane, Bala Cynwyd, Pa. For **Rockwell Manufacturing Co,** Edward Valves, Inc: Paul Bradfield & Co, 864 Robertson Blvd, Los Angeles, Calif., (formerly F J Hearty & Co). For **Bundy Tubing Co:** Atlantic Tube & Metals, Inc, Box 595, Mountain View, N. J. For **Peabody Engineering Corp:** Combustion & Power Equipment Ltd, Montreal and Toronto. For **Nordberg Manufacturing Co,** Sub-Contracting and New Products Dept: James T Wilson, special representative.

New Distributors

For **Resistoflex Corp:** Southeastern Plastics Sales Co, Atlanta, Ga. For **Tuthill Pump Co:** Misco, S.A., Dr Vertis 12, Mexico 7, D.F. For **Ampco Metal, Inc:** Columbus Welding Supply Co, 1236 Midway Drive, Columbus, Ga. For **Automatic Switch Co:** Morristown Electrical Supply Co, 23 Spring St, Morristown, N.J. For **Johns-Manville, Inc,** Industrial Insulations Div: Parker-Fallis Co, Inc, 1704 Orleans St, Dallas 10, Texas; 8300 Broadway, San Antonio 9, Texas.

Recent purchases, mergers

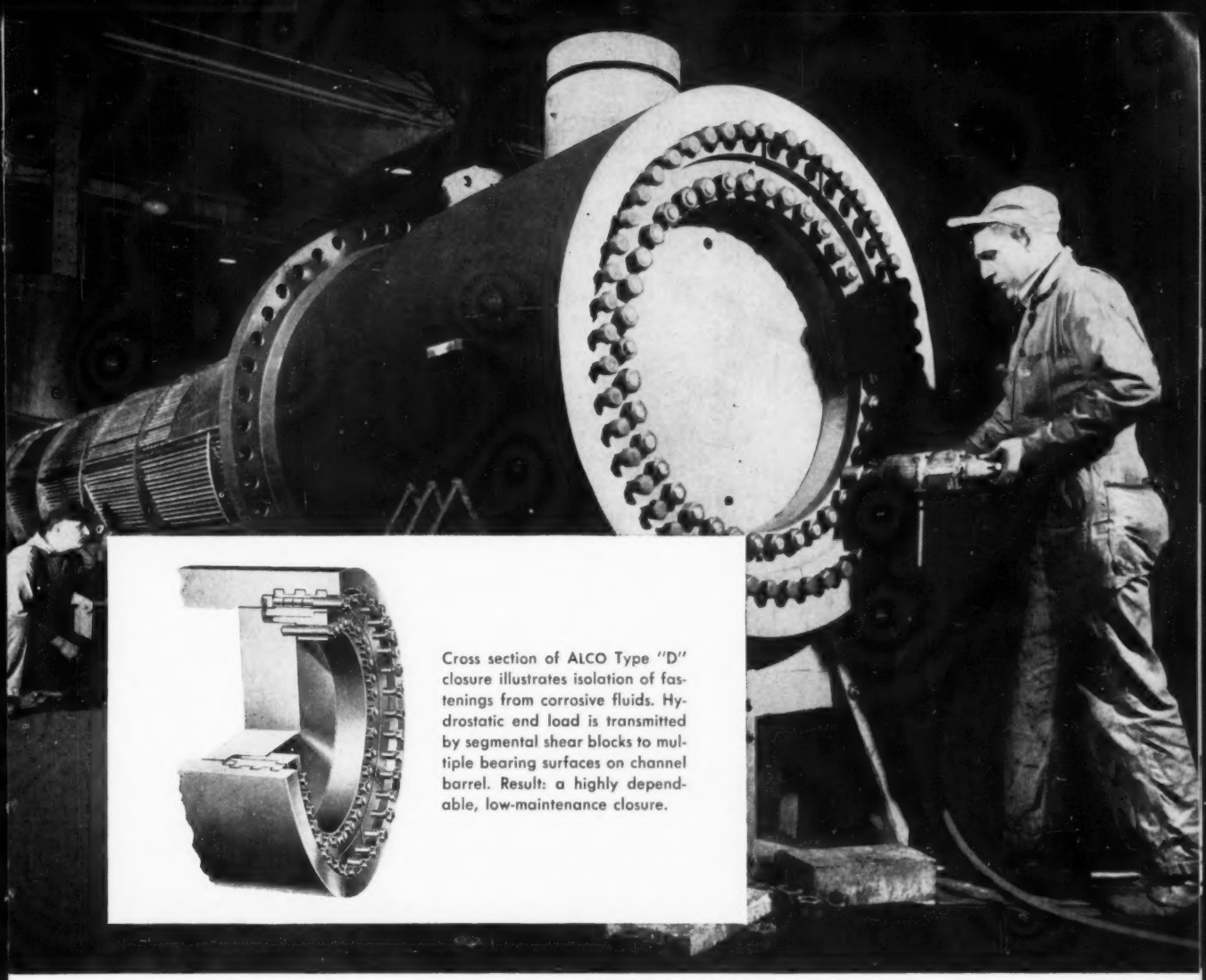
Air Reduction Sales Co: acquisition of Adelson-Werts, Inc. **Marshall & Wells Co:** consolidation with Air Engineering Co. **American Machine & Metals, Inc:** purchase of name and some assets of Rahm Instruments, Inc. **Johnson-Williams, Inc:** sales and servicing of Heiland gas indicator.

General sales manager

Norton Co, Electro-Chemical Div: Harlan T Pierpont, manager of sales. **Borg-Warner International Corp:** Marshall A Haislup, industrial sales; Elmore T McKenzie, appliance sales. **Acoustica Associates Inc:** Ralph Reynolds. **Greer Hydraulics, Inc:** Leonard H Seeman, manager of product sales engineering.

District sales managers

Calumet & Hecla, Inc, Wolverine Tube Div: Richard B Flynn, east central sales district; Jack H Smith, manager of districts. **Gould-National Bat-**



Cross section of ALCO Type "D" closure illustrates isolation of fastenings from corrosive fluids. Hydrostatic end load is transmitted by segmental shear blocks to multiple bearing surfaces on channel barrel. Result: a highly dependable, low-maintenance closure.

PROVED TYPE "D" CLOSURE PUTS EXTRA VALUE IN ALCO HIGH-PRESSURE FEEDWATER HEATERS

Mechanical locking arrangement makes tubes easily accessible without cutting or welding; closure can be easily dismounted and reassembled with hand tools

The ALCO-developed Type "D" high-pressure closure, standard on all ALCO high-pressure feedwater heaters, adds extra savings in operation and maintenance to these units. Its mechanical design permits access to the tubes without cutting open the closure and then doing expensive rewelding. Demounting and reassembly can be accomplished in a single shift—with significant savings in equipment down time.

The Type "D" closure is completely dependable. Extensive service in the country's largest steam-generating plants has proved its operation. Locking components and screwed fastenings are not contacted by the contained condensate, assuring easy disassembly of the cover. The screwed fastenings carry no hydrostatic end load so the gasket seal is not affected by fluctuating pressure.

It's another benefit of installing ALCO feedwater heaters in your plant. For years the toughest feedwater heating problems have been assigned to ALCO. Proof that ALCO has solved them is now in the country's largest high-temperature, high-pressure steam plants. ALCO evaporators, with their patented "Flextube" scale-shedding construction, are also proving their reliability and economy.

If you'd like more facts, we'll be happy to send you our Bulletins FH-2 and EV-1. They give complete details. Simply write Thermal Products Division, Dept. FHE-1, P.O. Box 1065, Schenectady 1, N. Y.

ALCO

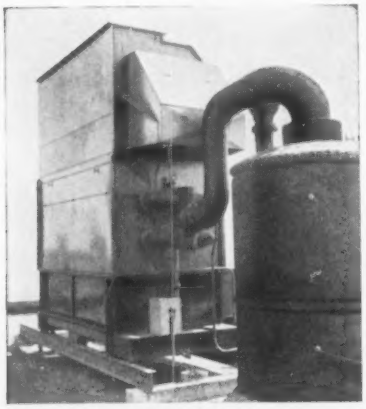
ALCO PRODUCTS, INC.

NEW YORK

Sales Offices in Principal Cities

Locomotives • Diesel Engines • Nuclear Reactors • Heat Exchangers • Springs • Steel Pipe • Forgings • Weldments • Oil-Field Equipment

This AIR-COOLED CONDENSER *produces a* HIGHER VACUUM



AT THE
CHEMICAL SHOW
26th EXPOSITION OF CHEMICAL INDUSTRIES
Coliseum, New York City, December 2 – 6, 1957
See NIAGARA . . .
AIR CONDITIONERS • *Aero* HEAT EXCHANGERS
Aero AFTER COOLERS • *Aero* REFRIGERANT CONDENSERS • *Aero* STEAM CONDENSERS
Aero VAPOR CONDENSERS • HUMIDIFIERS
HEATERS • COOLERS • DRYERS
BOOTH No. 655

● Using air as the cooling medium, the Niagara *Aero* Vapor Condenser produces a higher vacuum than other type condensers, and with more enonomy of power and steam.

It sustains its full capacity in cooling or condensing with no more than a nominal cooling water requirement, eliminating entirely your problems of water supply and disposal.

It holds constant the liquid or vapor temperature producing always uniform products and giving maximum production.

Non-condensibles are effectively separated at the condensate outlet, with sub-cooling, after separation for higher vacuum pump efficiency.

Niagara *Aero* Vapor Condenser can be mounted directly on the steel structure of your evaporator or distillation column. Its operation is dependable; its maintenance is not troublesome or expensive.

For more information write for Bulletin 129R

NIAGARA BLOWER COMPANY
Over 35 years of Service in Industrial Air Engineering
Dept. P-11, 405 Lexington Avenue
NEW YORK 17, N. Y.
District Engineers in Principal Cities of U. S. and Canada

More APPOINTMENTS

Begins on page 250

teries, Inc: Richard Relf, Detroit region. **Graybar Electric Co, Inc:** C R Cowning, Jr, Tulsa; F L Cummings, Denver. **Kelite Corp:** Lawrence W Cunningham, southern region. **George L Simonds Co:** Robert Bruce, Jacksonville. **Air Reduction Co, Inc,** Air Reduction Sales Co Div: H C Wallace, southern region.

New district offices

Babcock & Wilcox Co, Refractories Div: at 135 Cedar St, New York 6, N.Y.; at Romax Bldg., 731 James St, Syracuse 3, N.Y.; at 66 Central St, Wellesley 81, Mass. **The Colson Corp:** at 215 4th Ave, New York, N.Y. **Automatic Sprinkler Corp of America:** Ames Bldg, 2721 Park St, Jacksonville, Fla.

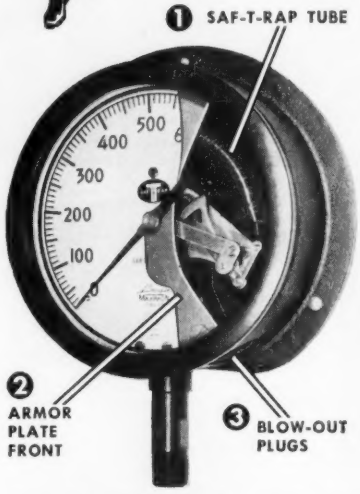
Recent moves

Sarco Co, Inc and **Sarcotherm Controls, Inc:** national headquarters to 635 Madison Ave, New York, N. Y. **Gibson Electric Co:** factory and offices to Delmont, Pa. **Acoustics Associates, Inc:** to 26 Windsor Ave, Mineola, L. I., N. Y. **Robertshaw-Fulton Controls Co:** executive offices to 911 Broad St, Richmond 19, Va. **Iron Fireman Manufacturing Co:** SelecTemp Div to W 106 St, Cleveland, Ohio. **Link-Belt Co:** plant to 1200 Sycamore St, Montebello, Calif.

Awards

Walter A Schmidt, president of Western Precipitation Corp, received the Frank A Chambers Award of the Air Pollution Control Association for "services in the control of air pollution."
Alfred Iddles, president of Atomic Industrial Forum, awarded George Westinghouse Medal, "for eminent achievement in the power field," by ASME.
Dr John Chipman, head of metallurgical department, M.I.T., awarded Gold Medal and senior award of ASM.
Dr Tokushicki Mishima, professor emeritus, University of Tokyo, received Albert Sauveur Achievement Award of ASM.
Scott Turner, former Director of the U. S. Bureau of Mines, awarded Hoover Medal for "distinguished public service," sponsored by AIME, ASCE, ASME, AIEE.
Fred D De Vaney, chief metallurgist, Picklands Mather & Co, will receive Robert H Richards Award of AIME.
Hjalmar W. Johnson, vice-president, steel manufacturing, Inland Steel Co, will receive the Benjamin F Fairless Award of AIME.
Dr. William L Everitt, dean of College of Engineering, University of Illinois, awarded AIEE medal in electrical engineering education for "outstanding service as a teacher."

"TRIPLE-THREAT" SAFETY...



LONERGAN'S NEW SAF-T-RAP® PRESSURE GAUGES

❶ New SAF-T-RAP Tube . . . special industrial tape wrapping which confines or smothers explosive effect when tube is ruptured.

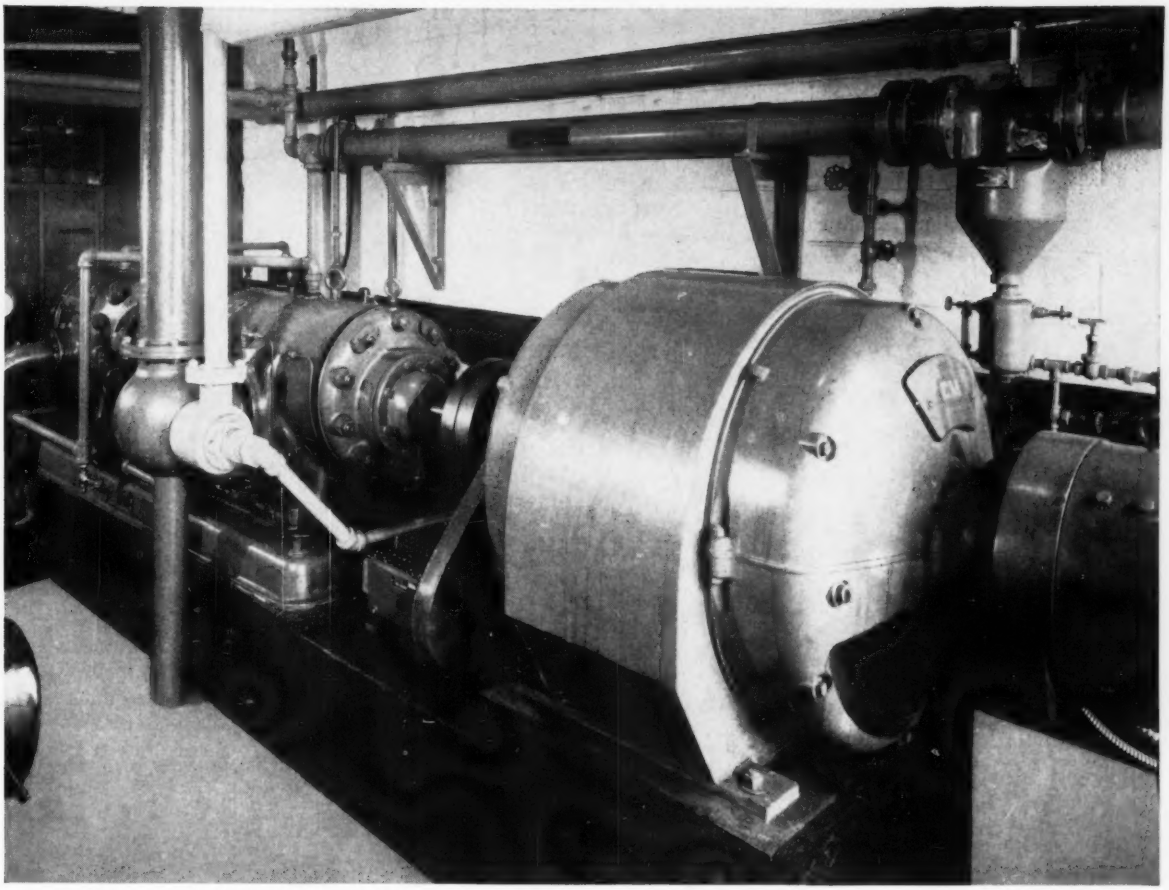
❷ New ARMOR PLATE FRONT . . . completely separates dial and dial front from tube and movement assembly . . . thereby containing any explosive force within solid cast housing.

❸ New BLOW-OUT PLUGS (Safety Vents) . . . provide positive insurance against any pressure build-up within the gauge . . . slightest pressure causes plugs to drop out.

Another big plus feature for new Lonergan SAF-T-RAP Gauges is *bored steel tubing*, carbon or stainless . . . a special machine *rifle bores* the tubes, producing a "mirror-like" finish which decreases the possibility of rupture and adds to the life of the gauge (it has been proved that tubes will often rupture at the point where there is a tool-score).

And, all of these new features for greater safety and longer life are available on Lonergan SAF-T-RAP Gauges with ARMOR PLATE FRONT . . . in pressures of 1000# and over. Write for further details.

ESTABLISHED 1872
Lonergan
J. E. LONERGAN COMPANY
2nd AND RACE STREETS
PHILADELPHIA 6, PA.



THEY'VE ORDERED FULLER ROTARIES AGAIN AND AGAIN . . .

The proof is the record. Reading Tube Corporation bought its first Fuller Two-Stage Rotary Compressor in 1944—a C50-50H. To meet expanding pneumatic power requirements for increased production, they added a C100-100H Rotary in 1946. Again, the only and obvious choice was Fuller. In 1953, Reading Tube installed its third Fuller Rotary—a C175-175H, and reports continued satisfactory and economical operation, with a bare minimum of maintenance on all three.

Reading Tube Corp. uses Fuller compressors exclusively for such variety of needs as supplying air power in their casting shop, mill, draw benches, in testing and packing, as well as for hand accessories such as grinding, polishing, drilling, etc.

Check these advantages when your plant needs reliable air power . . . . they've made Fuller the choice, time and time again.

. . . full capacity for life of the machine

. . . smooth air flow

. . . sustained performance for top capacities up to 3300 c.f.m. and pressures to 125 pounds

. . . compactness and ease of installation, requires minimum space and light foundation

. . . vibrationless due to absence of reciprocating parts.

To get all the facts, write today for Bulletin C-5A.

C-310
3894

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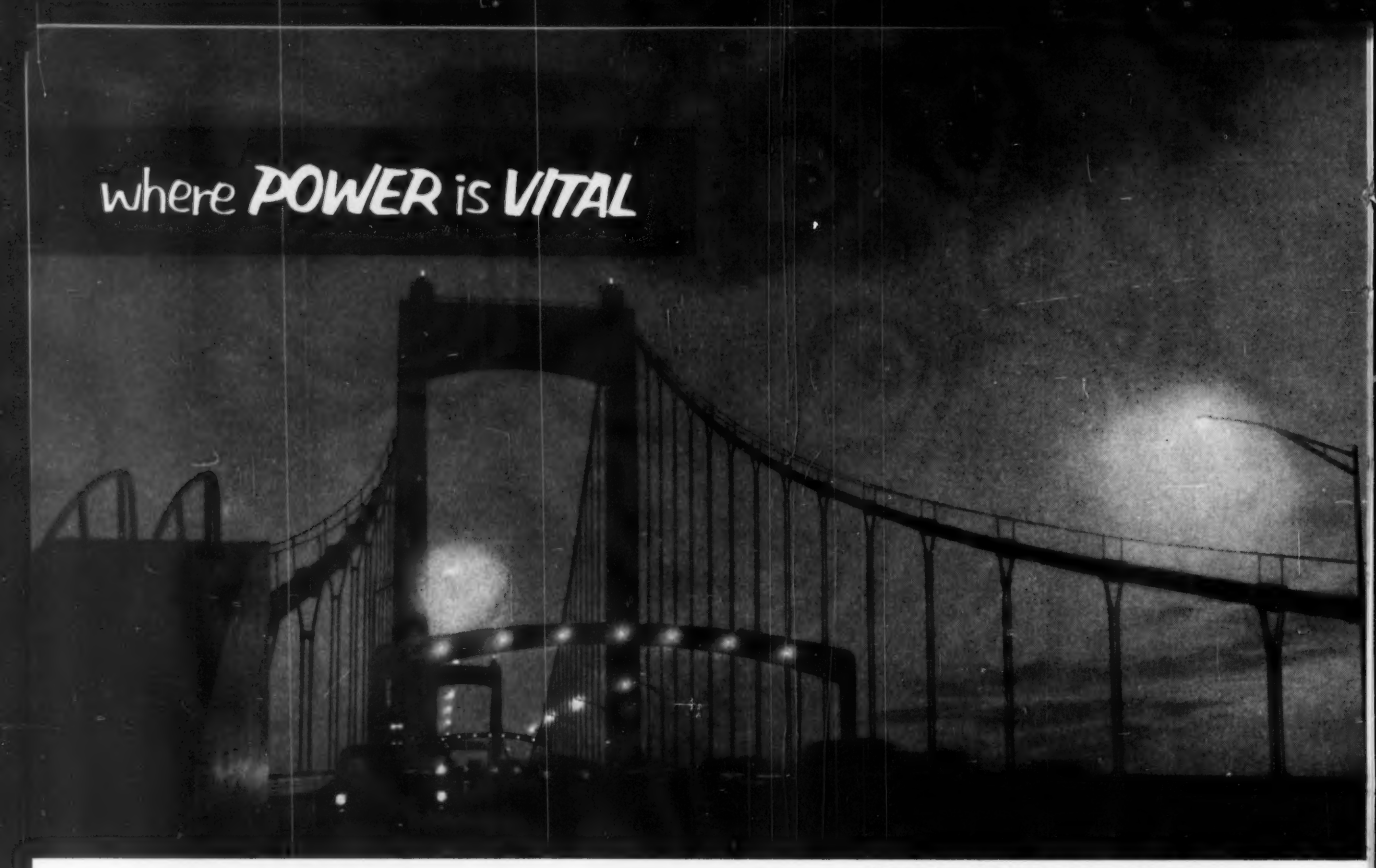
GENERAL AMERICAN
TRADE MARK

FULLER COMPANY
126 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
Birmingham · Chicago · Kansas City · Los Angeles · San Francisco · Seattle

Fuller

PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930



Night view of Walt Whitman Bridge spanning the Delaware between Philadelphia and Haddon Township.

ASCO TRANSFER SWITCHES assure continuous lighting and power on the Walt Whitman Bridge

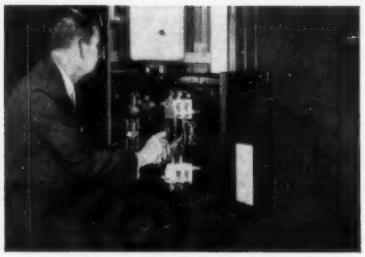
Along the seven-mile length of the new Walt Whitman Bridge, ASCO Automatic Transfer Switches stand ready to provide around-the-clock power insurance. Their duty: to transfer the bridge lighting and toll gate power and lighting load automatically to the alternate source in case of prime power failure.

In hospitals, communications, power plants – wherever lives and valuable equipment are at stake—ASCO transfer switches are specified for their inherent dependability:

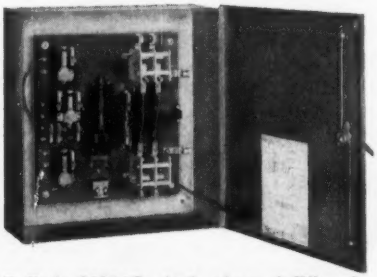
Check these advantages of ASCO Transfer Switches . . .

- *continuous duty rating* in either normal or emergency position
- *capacity to withstand* inrush currents 20 times full load rating
- *mechanical locking*, providing sure contact pressure
- *single coil design*
- *built-in time delay*, so that equipment ignores harmless momentary outages
- *accessories* to meet your specific requirements
- *full phase protection* and other design features

Write for Booklet 596 describing how to select an adequate transfer switch. Or write in *on company letterhead*, specifying Catalog 57-S1, covering complete line of ASCO automatic transfer switches.



Engineer checks ASCO Transfer Switch built into thirteen power stations spotted every 1000 yards along length of bridge.



Bulletin 90804C, single phase, 3 Wire, 2 Pole Transfer Switch provides full protection against line drop below 70% of normal. ASCO Transfer Switches in sizes from 100 to 1200 amperes in A-C and D-C voltages to 750 volts protect life and property in every conceivable installation.

Automatic Switch Co.
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ASCO®

don't waste steam

Nicholson steam traps have a powerful, intermittent valve action which closes the valve *completely*. Hardened stainless steel valve and seat are lapped and mated—there's no steam waste, no dribbling. And that's not all. With just one thermostatically-operated moving part, there's nothing to get out of order, nothing to go wrong. Nicholson means continuous and low-cost operation of your steam-using equipment . . . no downtime from trap failure.

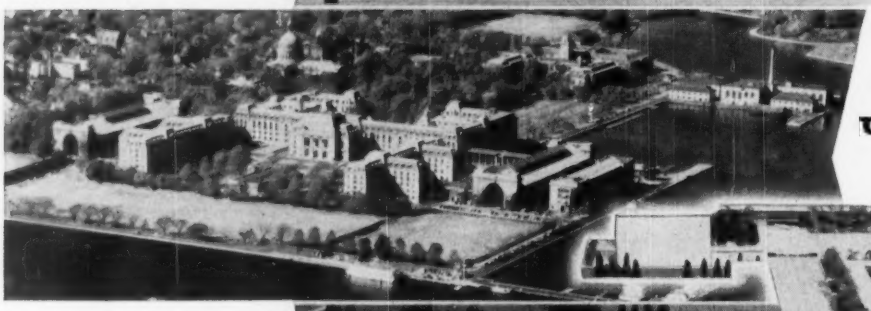
- **high air-venting capacity . . . for faster warmup of equipment.**
- **small and lightweight . . . easy to pipe and support.**
- **each unit steam-tested before shipment.**

So, to get a trap that avoids waste, saves money, specify Nicholson. W. H. NICHOLSON AND COMPANY, 14 OREGON ST., WILKES-BARRE, PA. *Sales and Engineering offices in 98 principal cities.*

Write for Bulletin 1055

NICHOLSON
of Wilkes-Barre

UNITED STATES MILITARY ACADEMY



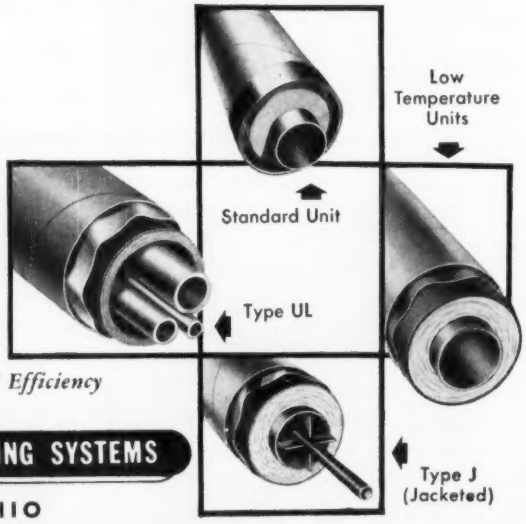
UNITED STATES NAVAL ACADEMY

UNITED STATES AIR FORCE ACADEMY

Photographs courtesy United States Military Academy, United States Naval Academy, and United States Air Force Academy.

Ric-wiL underground piping systems serve ALL three...West Point, Annapolis and NOW...the new Air Force Academy

West Point and Annapolis have been serviced by Ric-wiL piping systems as far back as 1931. Since 1946 alone over 15,000 feet of Ric-wiL prefabricated piping has been purchased for the nation's top military colleges. Installation of Ric-wiL piping at the new 17,500 acre United States Air Force Academy has already been installed. Ric-wiL is indeed proud of the part they have played in serving these military academies for a period of over twenty-five years.

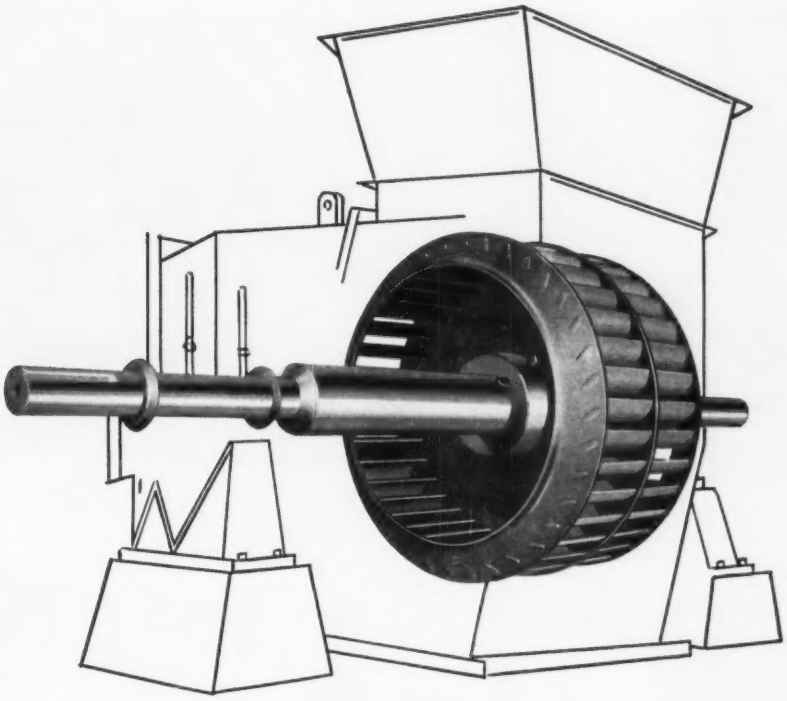


Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency
SINCE 1910

RIC-WIL INCORPORATED — PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO

IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED



CLARAGE TYPE DN DYNACURVE FAN OFFERS A

New Concept

IN INDUCED DRAFT WHEEL DESIGN

36 radially deep, aerodynamically curved blades impart a dynamic energy to the gas stream to achieve low tip speed operation.

Unique shape of the blades and rims minimizes shock losses and turbulence at the entering edge of the blades and between the blades.

Wheel design assures relatively low moment of inertia (WR^2).

Wheel is constructed with a heavy forged steel hub and a sturdy centerplate.

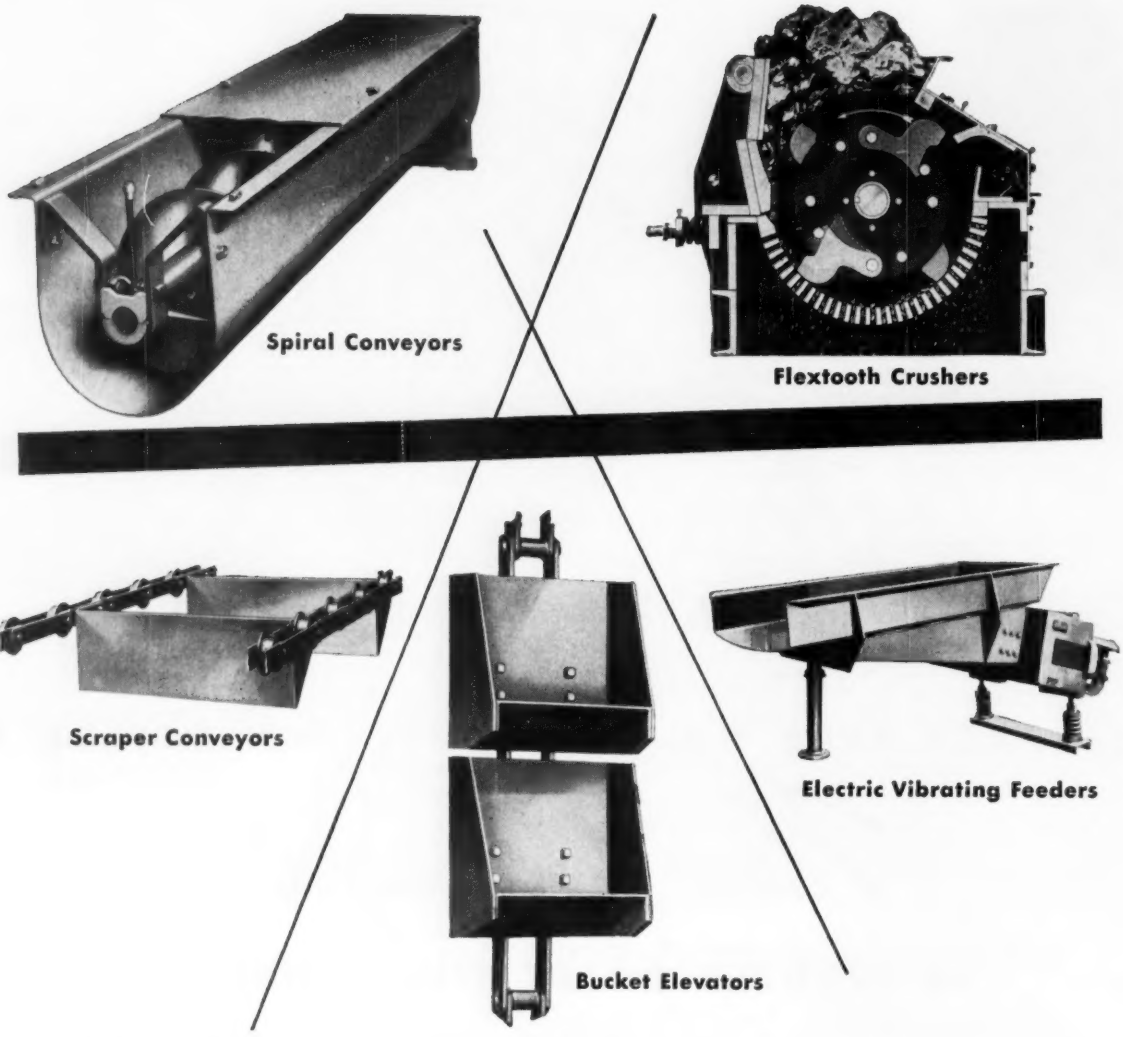
All welded construction of the wheel provides ample shear strength, tensile strength, and rigidity.

These are only a few of the features that make Clarage's new Type DN Dynacurve Fans fully equal to the most punishing demands.

Write today for Bulletin 905. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



JEFFREY DEPENDABILITY counts most in equipping and operating a power plant

A high standard of design, materials and workmanship has made Jeffrey coal and ashes handling equipment the choice of leading power plant engineers. Whether you're planning a complete plant or revamping an old one, consider these Jeffrey products—

Spiral Conveyors for distributing coal to bunkers and hoppers are ideal where space is limited and capacity demands are not high. Coal can be discharged at any point by means of valves in trough bottoms. Available in various standard lengths.

Flextooth Crushers reduce lump coal to uniform sizes in a single operation, assuring maximum efficiency for mechanical stokers. An adjustable breaker plate permits making a wide range of sizes.

Electric Vibrating Feeders regulate flow to belts, elevators, pulverizers, weigh hoppers, etc., drawing feed from track hoppers and storage bins. Operate on the level, up or down grade. Impart no vibration to supporting structures. Capacities up to 600 tons per hour.

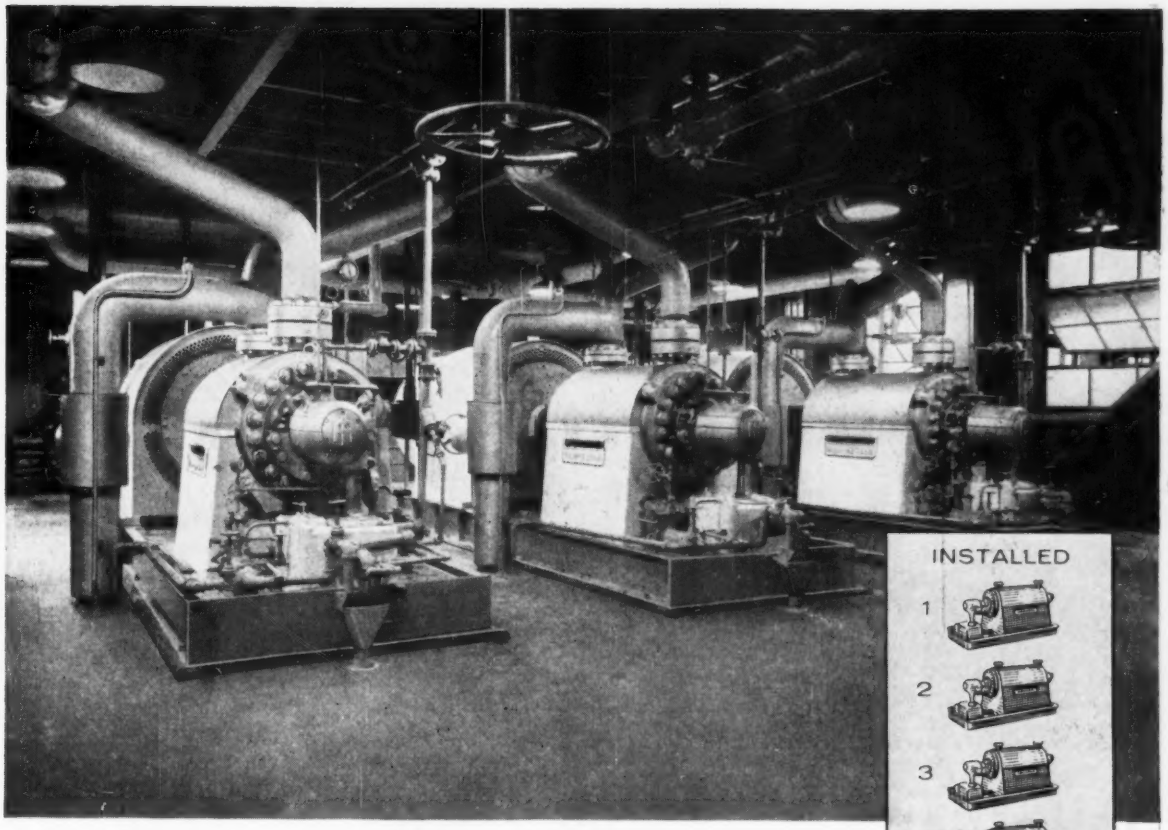
Bucket Elevators provide continuous handling of coal and ashes at low cost and require a minimum of space. Jeffrey furnishes elevators in various heights and in capacities of 25 to 40 tons per hour. Certain types can be employed for elevating and also for distributing coal to bunkers.

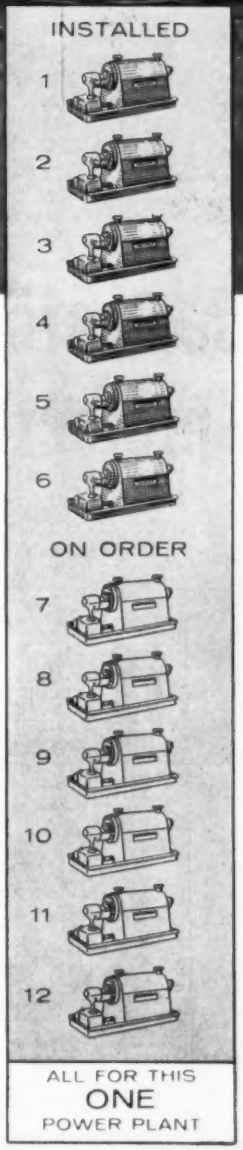
The Scraper Conveyor is one of the simplest of conveying units. Flights of various shapes, attached to either single or double strands of chain, drag the material in a steel trough. Operation may be horizontal or on an incline.

Detailed information on Jeffrey equipment for power plants is available upon request. The Jeffrey Manufacturing Company, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING





Twelve more reasons why CHTA pumps are

INDUSTRY'S FIRST CHOICE

for high-pressure boiler-feed service

THE three Ingersoll-Rand 5-stage CHTA boiler-feed pumps shown above are installed in a large southwestern industrial power plant – each unit handling 1150 gpm at 3775 ft discharge head. Three other 6-stage CHTA units are installed in the same plant, and six more are now on order.

Each of these 12 units is another vote of confidence in the *performance* and *dependability* of CHTA pumps. In case after case, repeat orders from satisfied users make them the most widely used pumps for high-pressure boiler-feed service in the 1000 to 6500 psi range.

The Unit-Type Rotor Assembly—a distinctive I-R feature – contributes to high sustained efficiency, maximum strength, easy maintenance and widest possible interchangeability of parts throughout the entire CHTA line. The many unique features and advantages of these advanced-design pumps are fully illustrated and described in Bulletin No. 7211.

Whenever you have a high-pressure boiler-feed problem, your Ingersoll-Rand representative will welcome the opportunity to help you work out the problem to *your* best advantage.

10-639

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

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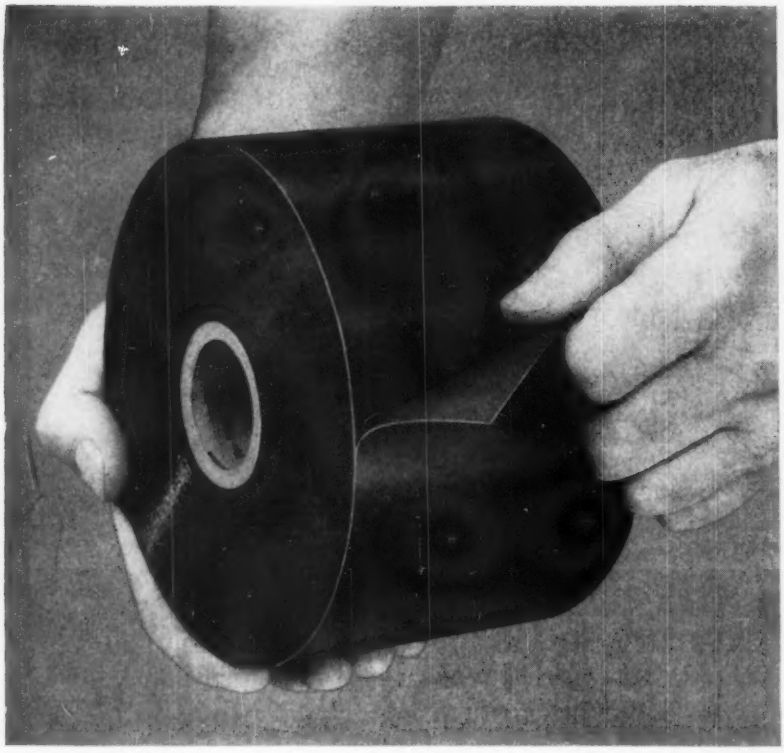

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"SCOTCHRAP" Brand Pipe Insulation is tough Polyvinyl Chloride Plastic Tape in roll form. *Sticks* at a touch and *stays* where it's put. Because it is so extremely rugged, so highly conformable, and so easy and convenient to apply, it is recognized as the leader in versatile, high-quality pipe protection. And "SCOTCHRAP" is easy to use . . . gives you complete corrosion protection immediately, without costly preparation, special tools, or dangerous flames. For better jobs, in less time, at less cost, always specify "SCOTCHRAP" Pipe Protection. Available in seven standard widths from 1 inch to 18 inches. *Made by the makers of* "SCOTCH" *Brand No. 33 Electrical Tape.*

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WELDED SEAMS on large diameter pipes are given practical, permanent protection by using wide widths of "SCOTCHRAP." Application is easy, fast, clean.

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SEND FOR FREE BOOKLETS describing protective qualities and easy application of "SCOTCHRAP." Write on your letterhead to: 3M Co., St. Paul 6, Minn., Dept. OO-117.

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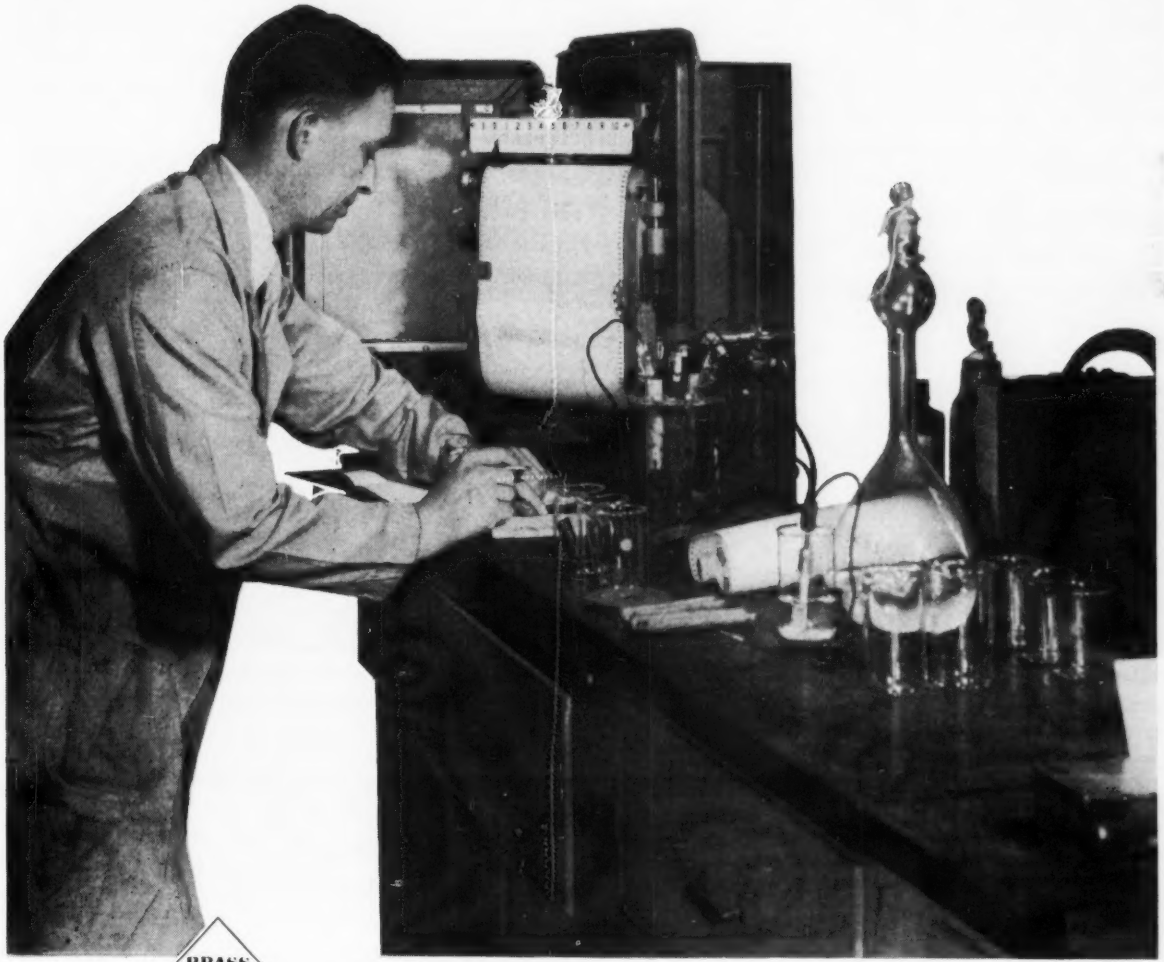
PRODUCT OF 3M COMPANY RESEARCH

What This Man Knows About Condenser Tube Corrosion Can Save You Money

This man is a member of Bridgeport's Technical Service Staff – an experienced team of trained, corrosion engineers who are always ready to give you prompt, accurate answers to your corrosion problems.

Through the years, he and his colleagues have built up a wealth of useful knowledge on all phases of condenser tube corrosion, its causes and its remedies. Backed by long manufacturing experience and by Bridgeport's extensive research facilities, he's ready to give you valuable assistance in selecting the condenser tube alloy best able to give greater service life and lower maintenance costs. Admiralty, Cupro Nickel, Aluminum Brass or other alloys – one of these alloys can meet your requirements and conditions. This man can tell you which one is best – and why.

Next time you're specifying condenser or heat exchanger tubes, call Bridgeport. There's a Sales Office near you.



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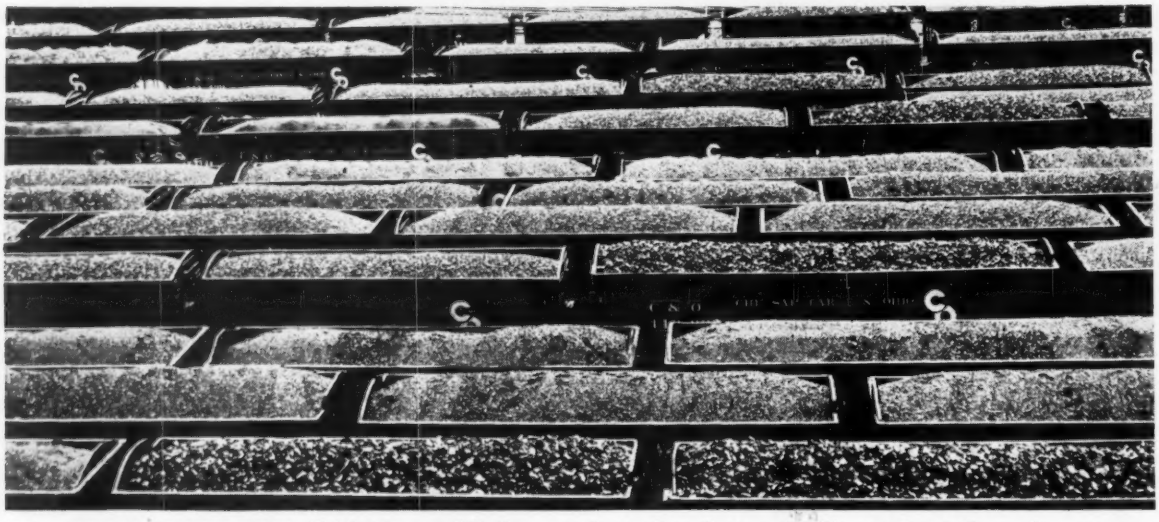
SUPERIOR COAL. This large battery of washing tables is an example of the modern methods used by producers on the C&O. The naturally superior coals found in the Chessie area can be sized and processed to meet your own particular requirements.



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For dependable sources of top quality coals, contact coal producers on the C&O. And for specific help in meeting your own fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake and Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

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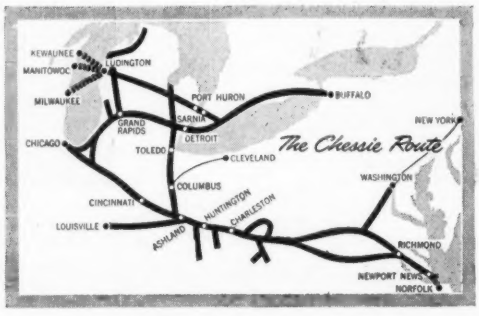

Here, for the first time, is a complete valve and remote control system — now offered as a "packaged" unit by S. Morgan Smith Co. It is designed to satisfy two basic applications, either singly or in combination:

Where you need precise positioning and indication.

Where you need remote control.

The system is made up of three elements: an SMS-Rotovalve or R-S Butterfly Valve, a "packaged" hydraulic positioner or electric motor operator installed next to the valve, and a master remote control and indicator unit, that may be located anywhere from a few hundred yards to many miles away.

For either modernization or new construction, this system makes possible savings in supervisory costs at remote stations, gives better operating control, and increases pumping efficiency. It is suited to:

Pressure control
Flow control
Pump check service
Throttling on a pump
Reservoir control
Altitude control
Sump level control
Effluent control
Filter water influent level control

To obtain full information on the completely new SMS valve and remote control system, ask for Catalog 164. It is available without charge through any of our representatives, or you may write to S. Morgan Smith Company, York, Penna.

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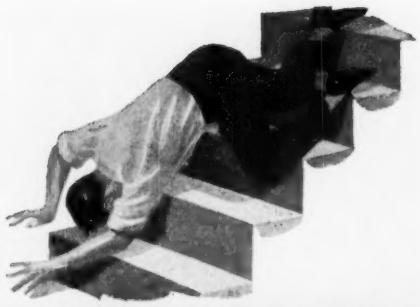
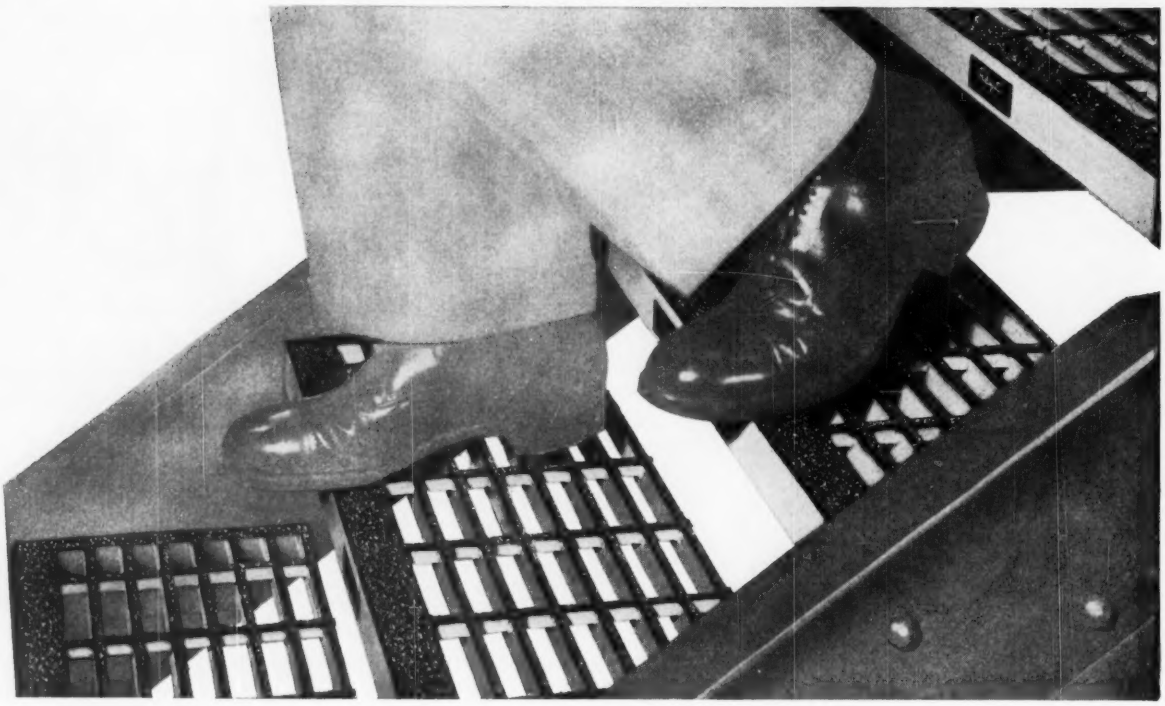
AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

7

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

Eliminate slipping accidents!

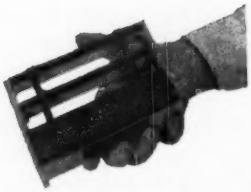




Relgrit® Abrasive Embedded Grating Treads

Industrial plants throughout the country have found that Relgrit has practically eliminated slipping accidents wherever used.

*Relgrit treads are made with an aluminum oxide abrasive, embedded in a "V" groove at the top of the grating bars and nosing. This forms a skid-proof surface that is virtually immune to wear; providing *permanent* protection from slippery surfaces due to water, mud, oil, grease, acids and chemicals. Relgrit is also made for platforms and all other grating areas.



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*You can't slip on Relgrit**

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Reliance Steel Products Company

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Relgrit Abrasive Gratings and Treads • Lightweight Bridge Flooring
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one pipe insulation... **UNIBESTOS®**

for every temperature from 80° to 1200° F.

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See how you save!

INVENTORIES SIMPLIFIED—only one type of insulation to stock.

EASIEST TO APPLY—standard methods, regular tools; cuts quickly without shattering or end-breakage. Refractory-coated smooth surface.

RESISTS IMPACT—virtually impervious to shock and vibration. Built to stay strong indefinitely.

WITHSTANDS MOISTURE, FUMES—insulating capacity is unchanged by long exposure to various chemical fumes. Submerged in water for weeks, it dries good as new.

POSITIVE HEAT-LOSS PROTECTION — No shrinkage; calcination and dehydration practically eliminated.

LOW THERMAL CONDUCTIVITY—means high insulating efficiency.

HEAT-TIGHT JOINTS—the fibrous nature of Unibestos leads to interlacing between sections for effective heat-sealing of joints.

SINGLE-LAYER APPLICATION—tests prove less heat loss with single-layer UNIBESTOS than with other double-layer insulations.

There's nothing like UNIBESTOS

If you're not using UNIBESTOS now, it's time to take a new look at pipe insulation. Costs come down all along the line with this all-purpose, long-lasting protection.

UNIBESTOS is quickly adapted for flanges, valves, fittings—needs no canvas cover, no additional protection within buildings. Shrinkage is negligible, even at 1200°, and it may be removed and re-used time after time without damage or loss of efficiency.

Long the world's largest selling high-temperature pipe insulation, today's UNIBESTOS is the one *all-temperature* pipe insulation. It costs no more, and only *one* insulation need be stocked on the job.

Small and thin or big and thick, sizes to 44" O.D. Made from long-fibered Amosite asbestos. UNIBESTOS assures outstanding economy, whatever the service or temperature.

HOW THICK SHOULD PIPE INSULATION BE?

Ask for UNARCO'S free 40-page Booklet F76-312 with exclusive "J" Factor Tables for easy, scientific thickness selection according to cost of fuel, hours of operation, life expectancy of installation, pipe size, temperature, and cost of insulating.

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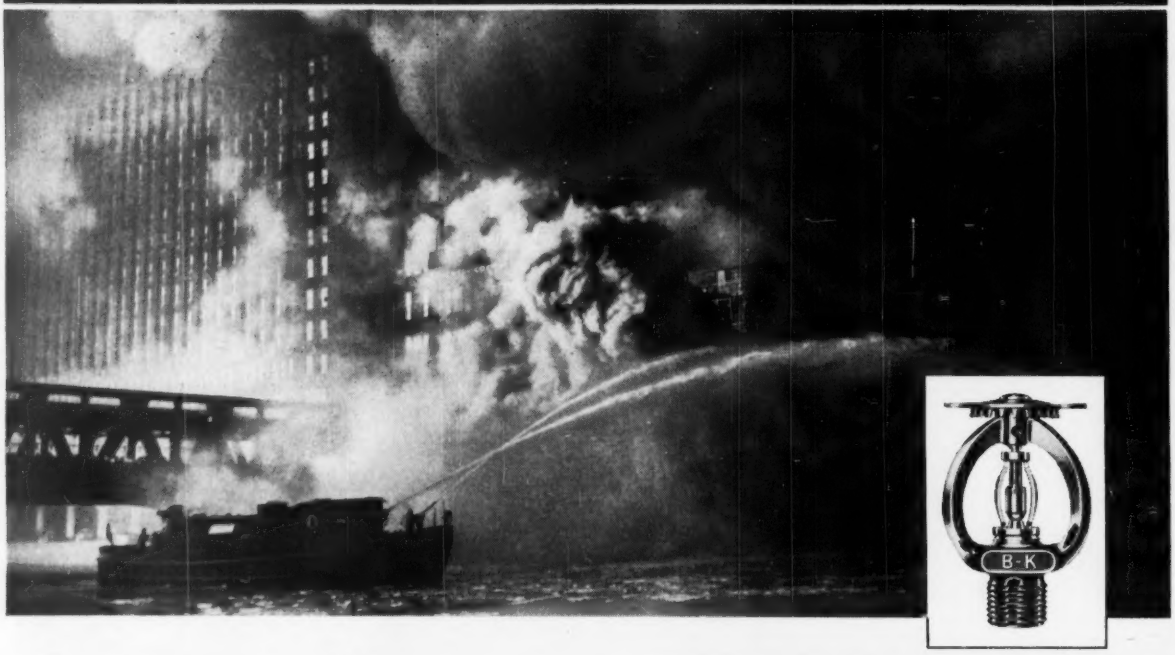
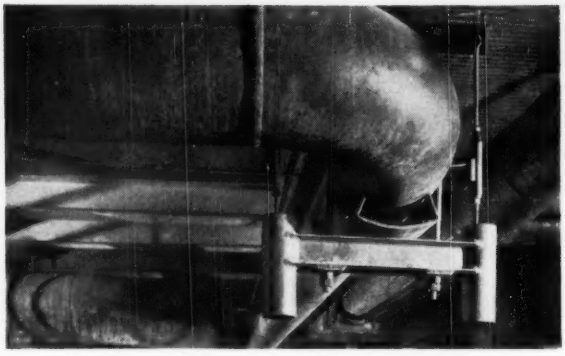
BLAW-KNOX has what it takes—to provide these products and services



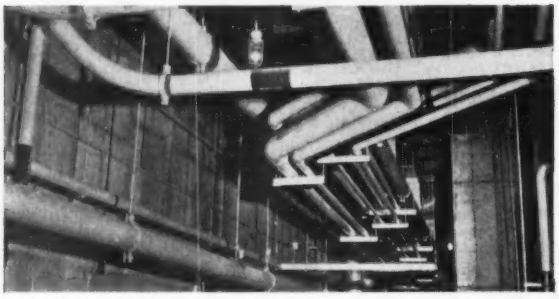
A Blaw-Knox automatic sprinkler system could have prevented this disastrous fire. Each year a serious fire strikes one out of seven manufacturing firms in this country. And out of every 100 firms who lose their records in a fire, 43 never reopen for business. So why take any chances.

Blaw-Knox engineers, fabricates and installs automatic sprinkler systems that are always alert to detect, confine and quench a fire at its origin. Qualified engineers custom-design systems that meet individual requirements—and fulfill all insurance standards and municipal codes. A Blaw-Knox automatic sprinkler system pays for itself in a few years through savings in reduced insurance premiums.

Let a Blaw-Knox fire-protection engineer study your needs, submit a layout and estimate, and tell you how you can pay for the system on our lease or deferred payment plan. For more complete information, write for Bulletin No. 2426—"Fire Can Destroy Your Business."



Blaw-Knox trapeze functional spring hangers, with the patented internal swivel action, support power piping in new generating station. Our experienced engineers are available to both design and make recommendations for your hanger requirements. For further information, send for Catalog No. 54.



High temperature, high pressure oil tunnel piping in large steel mill is typical of many piping systems prefabricated and erected by Blaw-Knox. Experienced piping engineers, modern shop facilities and a new Blaw-Knox digital computer method for fast, accurate calculation of piping stresses are available to you. Let us know your requirements and we will provide the service you need. For additional information, write for Bulletin No. 2443—"Piping for Industry."

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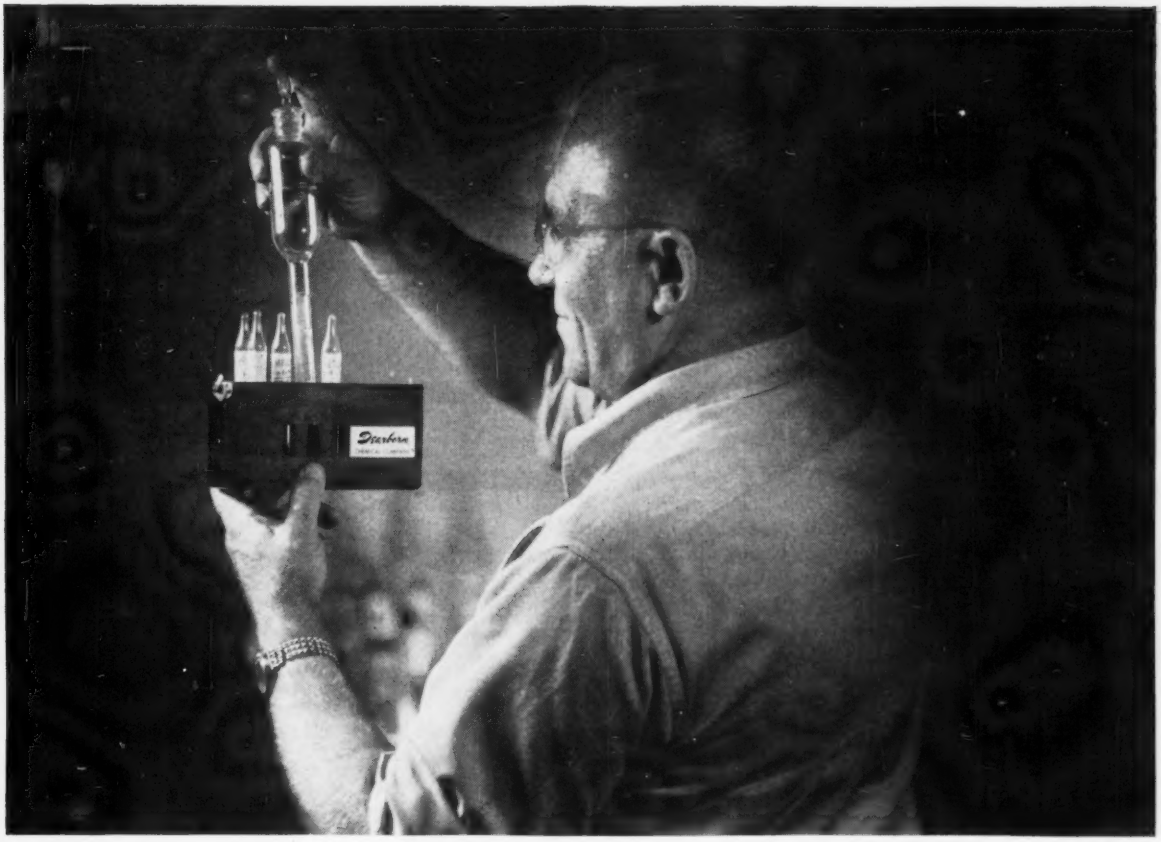
Complete facilities for prefabrication and erection of piping systems for all pressures and temperatures . . . complete line of standard and custom-engineered pipe hangers, supports and vibration eliminators . . . complete line of automatic sprinkler systems for standard and special hazards



Now! Test for Filming Amine Content in Minutes with New $29.50 Dearborn Kit

Now you can test for active filming amine (octadecylamine) residual in steam condensate...quickly, accurately and inexpensively.

It's this simple. All you do is take a sample of the condensate and follow the simple test directions. The final step of the test is to compare the resultant color of the sample with the permanent Color Standard set. The results indicate octadecylamine residual in ppm.

With this easy-to-use kit you completely eliminate guesswork on dosages to assure positive corrosion control of the entire system at lowest possible treatment costs.

Dearborn Test Kit consists of Extraction and Color Comparison Tube, Distilled Water Ampoule, Permanent Color Standards, Comparator Block and necessary solutions. Complete price: $29.50.

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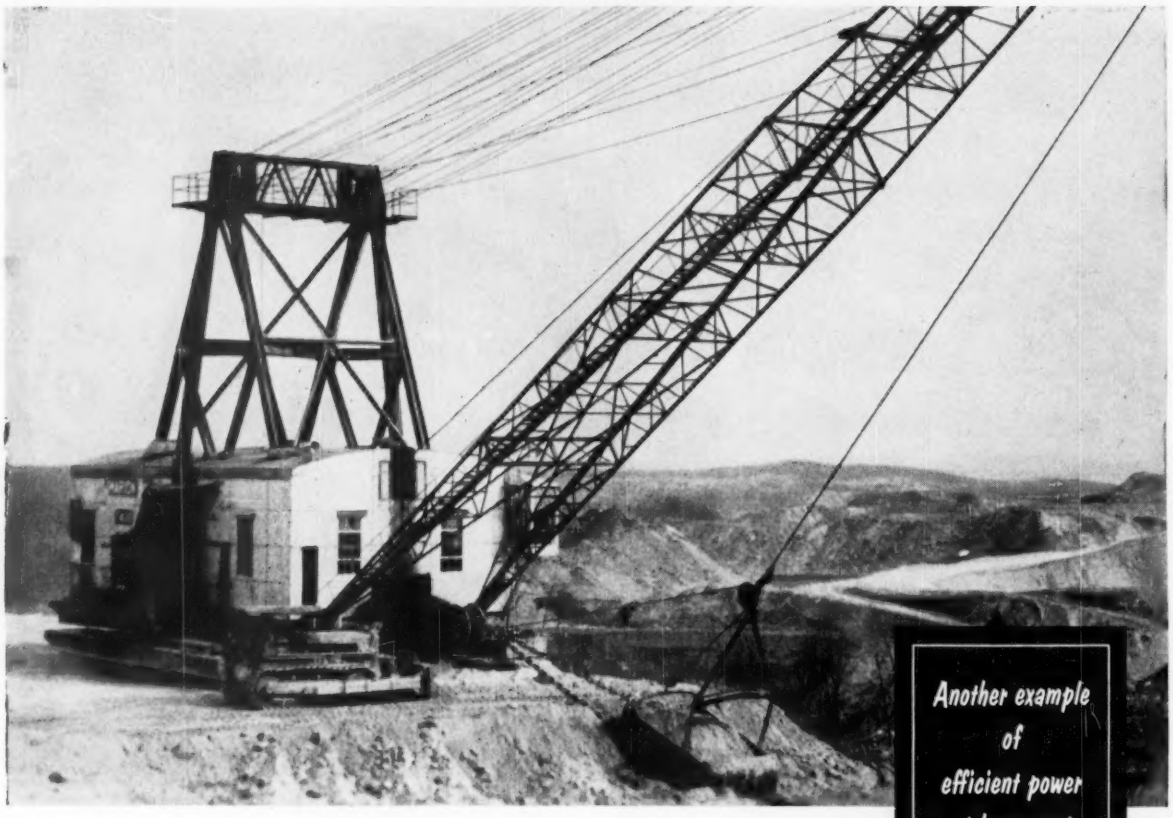

This Cooper-Bessemer-powered Marion 7400 walking dragline, owned by the Ohio River Collieries Company, is shown stripping overburden from coal deposits near Cheshire, Ohio. The diesel engine is an 8-cylinder Cooper-Bessemer JS, rated 750 hp.

Every month . . .
this COOPER-BESSEMER POWERED DRAGLINE
strips 350,000 yards of overburden

• The Ohio River Collieries Company, operating near Cheshire, Ohio, is now producing 40,000 tons of coal every month. And topping the list of important equipment is a Marion 7400 walking dragline powered by a 750 hp Cooper-Bessemer JS diesel engine.

At work 24 hours a day, 7 days a week, this Cooper-Bessemer powered dragline must strip 35 feet of sandstone and 10 feet of slate to reach valuable coal deposits.

It takes a heavy-duty power plant, with lots of flexibility and stamina, to stand up under conditions like these. Here, to list only a few, are reasons why such a schedule is more routine to a Cooper-Bessemer. There's advanced metallurgy for high strength construction, oversized crankshaft, extra bearing area, precision honed cylinders, tin-plated pistons and unique piston cooling.

Next time *you* need power in the 200 to 5000 hp range . . . mobile, stationary, locomotive, marine . . . get *all* the facts from Cooper-Bessemer.

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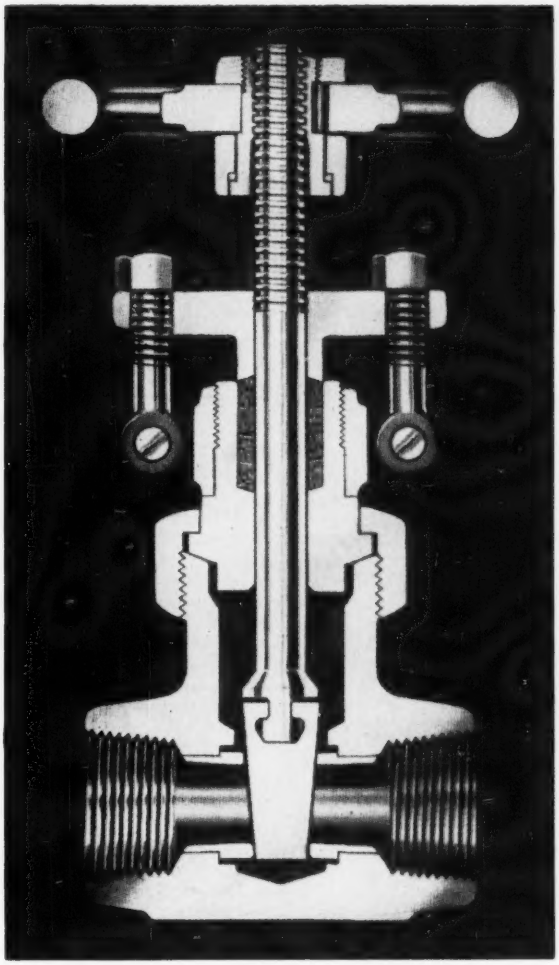


The Feeling is
MUTUAL

CHAPMAN LIST 960
Forged Steel Gate Valves

You want small steel valves that give the best performance and cost the least for maintenance. Chapman thinks the same way and does everything possible to give you what you want.

On Chapman List 960 Forged Steel Gate Valves the wedge faces are *super* hard. They're hardened to 800 Brinell by Chapman's exclusive Malcomizing process. They can't seize. They can't gall. They're built for rugged service.

Even the long lasting seat rings are hardened stainless steel and are very easy to replace when necessary. Also, you have no full-pressure repacking difficulties with Chapman List 960 valves.

Today, there are more Chapman List 960 valves on more jobs than any other small forged steel gate valve. Valve men and Chapman see eye to eye on performance and costs. List 960's come in sizes from ¼" to 2". They stand up perfectly under conditions from 380 psi at 1000°F. to 2000 psi at 100°F. Of course, for higher pressures you use Chapman List 990 valves.

With the 960's you can order Bonnet joint either gasketed or ground metal-to-metal. You can have rising stem with yoke or rising stem with inside screw. You find them all in our Catalog 10. Write today for a copy.

The CHAPMAN
Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS

Filters

Basic filter parts include: the outside container, the bed of filter medium and the distribution and collection systems to provide a uniform flow through all parts of the bed. Flow rates average 2 to 3 gallons per minute per sq. ft. of bed area.

Filter beds are cleaned periodically by reversing the flow and increasing it to about 10 to 20 gpm per sq. ft. (backwashing). This lifts and swirls the sand, loosening the dirt and flushing it to waste.

Rotary surface washers with high-velocity water jets may be used to help break up the layer of dirt on top of the bed.

After backwashing, the first water through the filter (rinse water) also picks up some dirt and is run to waste.

A "multiport valve" replaces 5 individual valves and reduces the number of valve manipulations for cleaning a filter from 10 to 3. It also indicates the cycle in progress and ensures proper sequence. Operation can be made completely automatic with hydraulically- or motor-operated valves controlled by meters, timers and float switches.

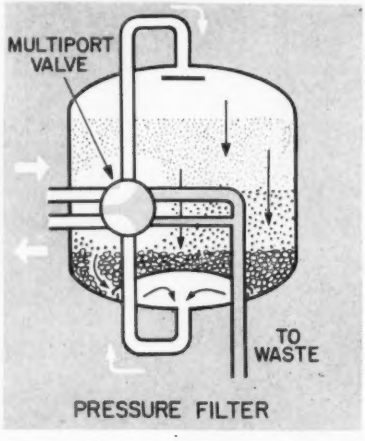
SAND FILTERS for removing dirt, precipitates, suspended solids

Sand filters simply "strain" the water as it flows downward through the filter bed. It is probably the oldest and most widely used method of water treatment.

Gravity filters. Practically all large public water-supply plants include a series of gravity filters made of concrete for permanence and low maintenance cost. Sizes run up to 400 or 500 sq. ft. for each filter.

Chief difference among concrete gravity filters is the method of water collection under the filter bed. The false bottom system provides uniform collection but requires about 2 ft. extra filter height and is highest in cost. Header-lateral collection systems of steel pipe are lowest in cost but do not provide perfectly uniform collection and can corrode. There are also patented systems such as Permutit's *Monocrete*® system which uses collapsible forms for casting lateral ducts in the concrete itself. *Monocrete* ducts are oversize for uniform collection and are corrosion-free since no metal is used. The cost is less than for false-bottom construction.

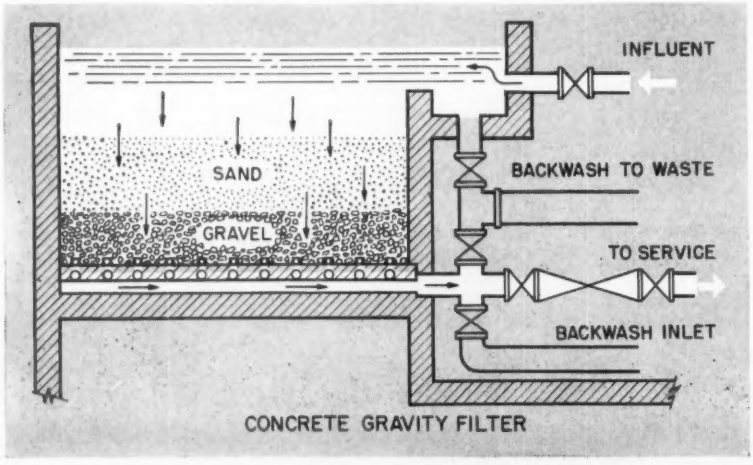
Steel-tank gravity filters cost less than concrete in small and medium sizes and are generally used in industrial plants. Wood-tank filters have low maintenance cost, but they are not practical for large sizes and not as attractive as painted metal. They are now used primarily where there is a metal shortage.



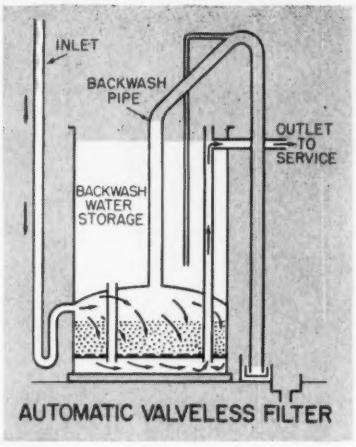
PRESSURE FILTER

Pressure filters deliver an effluent under pressure, usually under 100 psi, to eliminate repumping. Since no water depth is required over the bed to provide pressure, these filters are smaller and lower in cost than gravity filters of the same capacity.

Vertical pressure filters are available to 12 ft. diam. with approx. 113 sq. ft. of bed area. Horizontal pressure filters provide large filter-bed areas, up to 200 sq. ft., at lowest tank cost but may not maintain as uniform bed conditions as vertical type.



CONCRETE GRAVITY FILTER



AUTOMATIC VALVELESS FILTER

Automatic Valveless Filters (gravity type) are a new Permutit development. They greatly reduce filter cost because they use no valves or flow controllers. They provide completely automatic, foolproof self-operation yet actually cost less than conventional manually-operated gravity filters. Sizes up to 12′ diam. available.

When the suspended matter removed by the filter bed causes the pressure loss to reach a predetermined figure, backwashing starts automatically. At end of backwash, flow reverses automatically, and the backwash storage compartment is then filled with a brief rinse plus filtered water. Filtered water then passes to service through a separate outlet.

FILTER MEDIA for removing oil, bad tastes, odors, etc.

Graded anthracite coal. Used in place of sand to minimize pick-up of silica following hot-process softening of boiler feedwater or for removal of oil from steam condensate.

Activated Carbon (Carbo-Dur®). Absorbs excess chlorine and dissolved elements caused by decayed vegetation or algae that affect taste and odor. Carbon filters or "purifiers" are backwashed to remove suspended matter picked up by the filter.

Calcium Carbonate (Neutralite) raises the pH of low-pH, corrosive water at the same time that it filters.

Manganese zeolite oxidizes and removes moderate amounts of iron and manganese, also hydrogen sulphide, chief cause of "rotten egg" odor and sulphur taste. It is regenerated with potassium permanganate.

For information on filters or other water-conditioning equipment, write: The Permutit Company, Dept. P-11, 50 West 44th St., New York 36, N.Y. or Permutit Company of Canada, Ltd., Toronto 1, Ont.

PERMUTIT®
rhymes with "compute it"
A DIVISION OF PFAUDLER PERMUTIT INC.
Water Conditioning
Ion Exchange • Industrial Waste Treatment

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Learn the facts about money-saving, custom-engineered SOLA-FLEX® expansion joints

FORTY OF AMERICA'S fifty largest businesses are users of Sola-Flex expansion joints. They know that Sola-Flex joints are custom-engineered to meet every piping need, no matter how tough the temperature or pressure demands. And Sola-Flex joints are economical, too—in initial cost and long life.

They are made from a variety of stainless and high alloys, from ½ inch to 35 feet in diameter. They handle pressures up to 3500 psi for special applications. And they are being built for service from −320F to 1200F.

It will pay you to learn more about Solar's complete line of industrial bellows and expansion joints. Send for this new folder today. Write to Department D-106, Solar Aircraft Company, San Diego 12, California. *Designers, developers and manufacturers of gas turbines, expansion joints and aircraft engine, airframe and missile components.*

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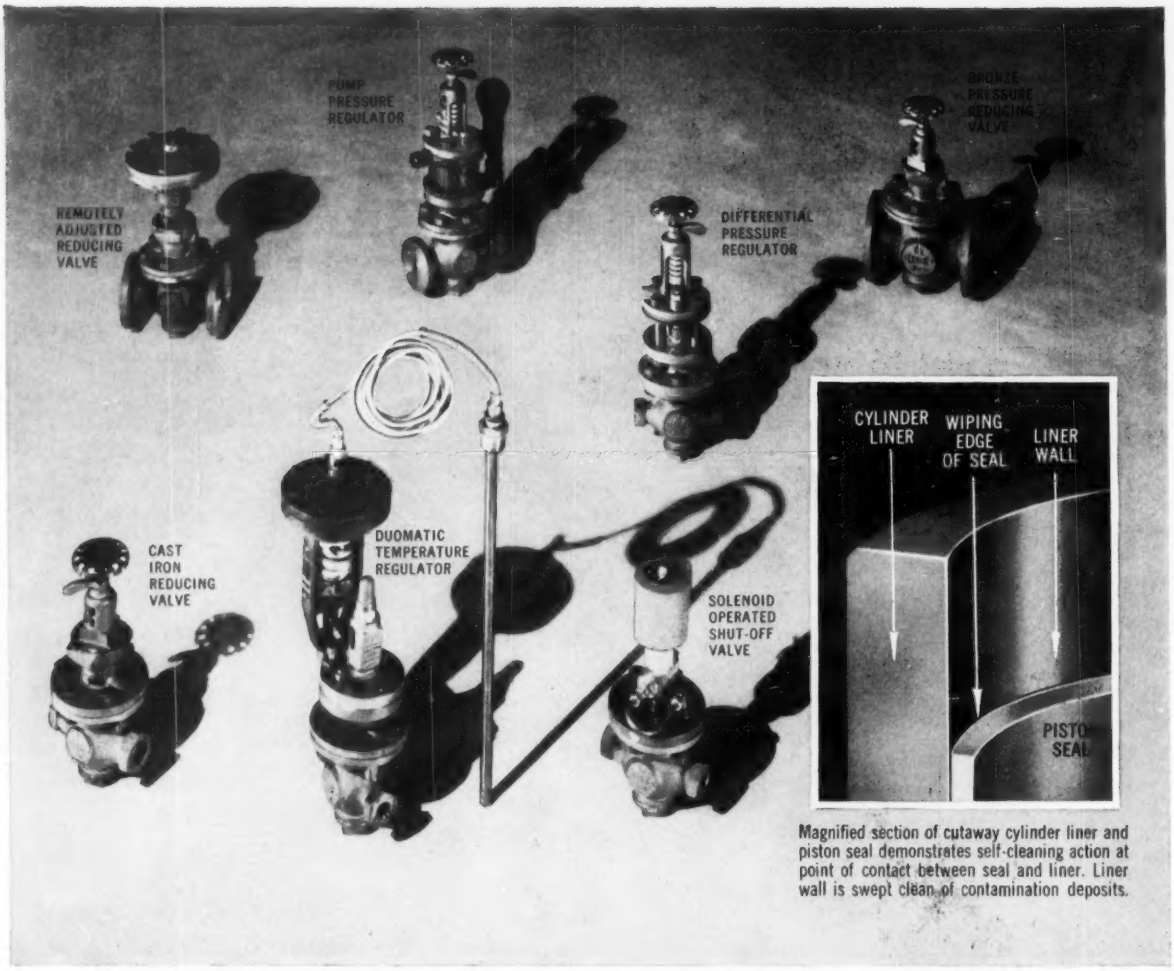
ENGINEERS WANTED. *Unlimited opportunities, challenging projects, good living with Solar! Send for new brochure.*



Magnified section of cutaway cylinder liner and piston seal demonstrates self-cleaning action at point of contact between seal and liner. Liner wall is swept clean of contamination deposits.

. . . another LESLIE Quality First!

REGULATORS WITH SELF-CLEANING PISTONS

. . . at no extra cost

Now it can be told! After 3 years of exhaustive field tests and over 5,000 installations, Leslie announces the standardization of exclusive self-cleaning, pressure sealing pistons for reducing valves, temperature and pressure regulators in ½ to 6″ sizes — another Leslie FIRST!

Continuous Wiping Action

The continuous "wiper" action of the new piston's seal keeps the cylinder liner clean, improves reliability, reduces maintenance.

The molded self-lubricating piston seal has already proved itself in high temperature service up to 500°F.

Reduces Wear and Sticking

The resilient cushion between the piston and cylinder liner reduces wear and eliminates "freezing" or sticking of these parts. The self-lubrication and pressure-sealing of the new piston insures smooth, dependable operation even in the toughest applications and where long standby periods are a problem with ordinary regulators.

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You can have this desirable new Leslie FIRST in *any* piston-operated Leslie regulator now in steam service for all temperatures up to 500°F. A quick conversion kit is available and your present Leslie Regulator can have the new seal added in a matter of minutes.

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Data Sheet RV-51C — Instructions for converting your present Leslie Regulator to self-cleaning piston type

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Or ask to see a demonstration model of the new pressure seal piston.

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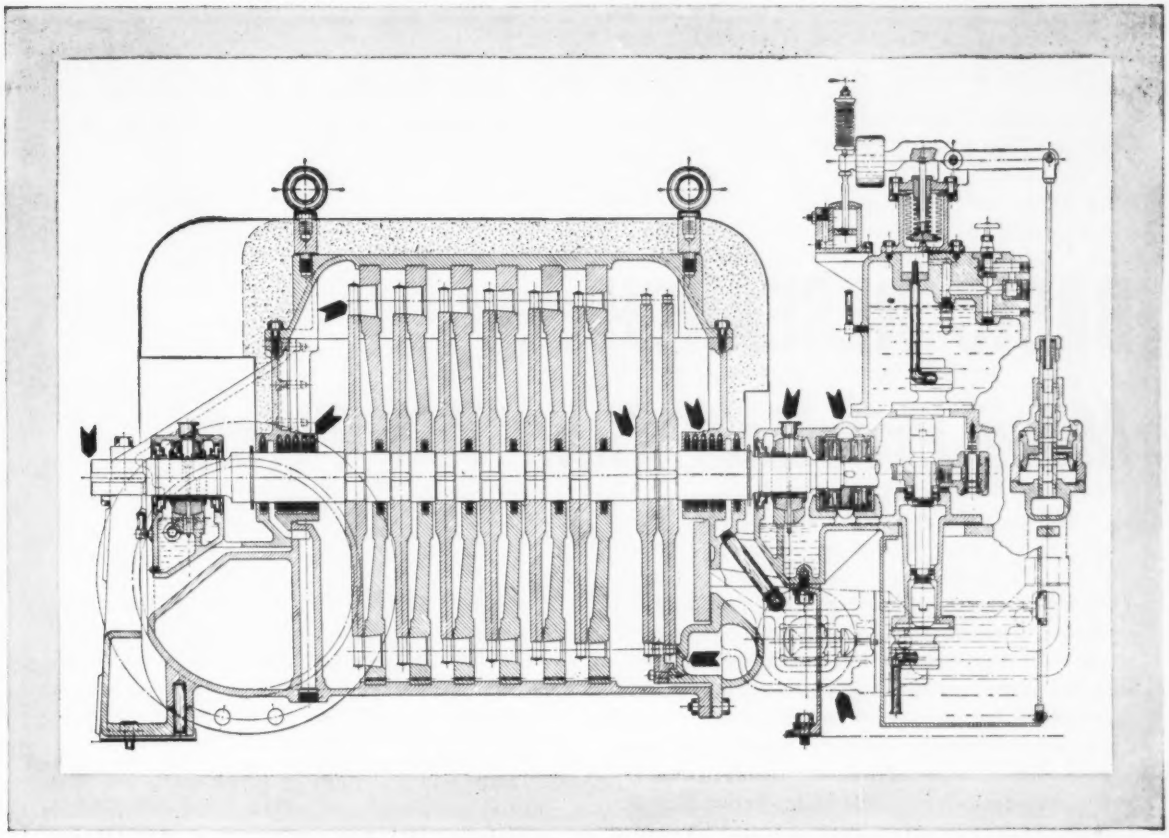

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BASIC RESEARCH . . .
More Practical Than You Think

This editorial, one of a special series on the importance of research to the American economy, deals with an aspect of our research program that may have serious consequences in future years — the lag in basic research.

An earlier editorial in this series noted: "The keen interest of U. S. business firms in scientific research points the way to a new kind of prosperity for our economy — a prosperity based on deliberate creativeness." As a result of the dramatic increase in industry's research expenditures, more new products will be introduced in the years 1957-1960 than in any previous four-year period.

A steady stream of new products and new processes means better values for consumers and lower costs for business. And thus it promises to sustain a high level of general prosperity that defies the old laws of boom and bust. **But, as we look further ahead, there is a danger that the stream of research discoveries may run dry because of our neglect of basic research.**

This danger was described by John Jay Hopkins, late founder and chairman of the General Dynamics Corporation: "Unless there is a revolutionary development in America of pure, not applied, science, there will come a day when there is no use in trading in your old car; because the new one is no better. The only difference between this year's television set and next year's will be the appearance of the cabinet! Scientific progress will be replaced by scientific stagnation."

What Basic Research Is

Basic (or pure) research has been characterized as the pursuit of knowledge for its own sake rather than to fulfill some practical objective. It is generally carried out in an environment which allows the investigator the freedom to follow the lead of his curiosity. The scientist in basic research, in the words of Glenn T. Seaborg of the University of California, is not concerned with "utilitarian goals, but a search for deeper understanding of the universe and the living and inorganic phenomena within it."

Impractical as basic research may seem in its initial purpose, it is an essential prerequisite to applied research and product development. A few examples will show how some of the greatest technical advances of recent years have come from basic research projects that had no immediate practical objective:

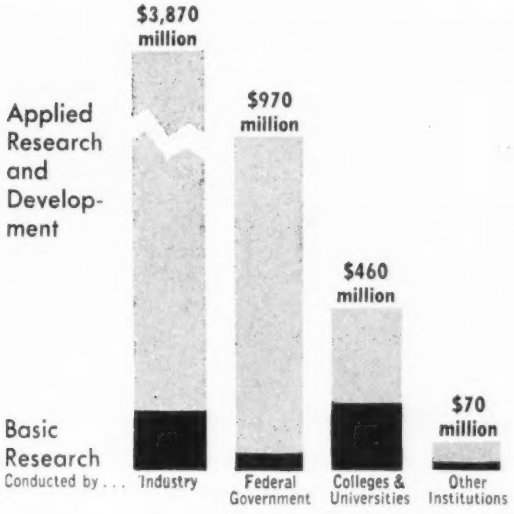
- **Radar** — an important military development of World War II with broadening commercial applications — was the outgrowth of a basic research project whose purpose was to obtain information about the height of the ionosphere, the layer of air that lies some 25 miles above the earth's surface.

- **Transistors** — the miniature devices which are already vital components of hearing aids, pocket radios and a wide variety of industrial equipment — were invented at Bell Laboratories (research subsidiary of the American Telegraph and Telephone Company) following university investigations into the electrical behavior of solids.

- **Neoprene** — a synthetic rubber — was developed by duPont with the help of basic information provided by Father Nieuwland of Notre Dame, who discovered he could control the polymerization (the linking together of molecules) of a certain class of organic compounds.

- **Nylon** — the first of the noncellulosic synthetic fibers that have revolutionized the textile industry — grew out of fundamental research by Dr. Wallace Carothers on long-chain polymers.

Only 8% of All Research and Development in the U. S. is Devoted to Basic Research



Data: National Science Foundation, "Funds for Basic Research in the United States, 1953"

Industry's Stake in Basic Research

Industry traditionally has relied upon colleges and universities and other nonprofit institutions for basic research; and the U. S. has long benefited from the greater emphasis placed on basic research in Europe. It is conventional to think that business cannot, and should not, do much about "ivory tower" projects which do not have immediate practical application.

However, there is not so much in this idea as is supposed. The examples above illustrate what Caryl Haskins, president of the Carnegie Institution, has called "the widespread paradox that the most important practical consequences are commonly the least sought after." Furthermore, it is certain that, without adequate basic research, industry's efforts to produce new and better products will become progressively more difficult. And our national defense, in an age of breathtaking military applications of science, will become increasingly precarious.

In the past, our economic growth came largely through expansion into new lands or through discovery and development of rich deposits of natural resources. Such opportunities are relatively limited today. The great opportunities now lie in discovering new materials and new properties of the materials we already have. **This is the job of basic research, and industry has a vital stake in it.**

The chart indicates the tiny share of research efforts in the U.S. that is devoted to basic research. **Only 4% of all research by industry, and only 8% of all research in the U.S., during the year 1953** (the latest for which information is available) **represented fundamental research to add to overall scientific knowledge.** Even in colleges and universities less than half the research performed is basic research. At least one Nobel Prize winner has expressed the belief that we need and should work toward a doubling of the proportion of our total research effort that is devoted to basic research as soon as possible.

What Business Can Do

Without anything like a staggering increase in the total cost of its research programs, industry could do much to expand our basic research effort. Companies with big research programs should, as a matter of successful survival, be devoting a share of the effort in their own laboratories to basic research. Significantly, companies that are already doing a notable job of basic research have also made an outstanding record of translating such research into new products for industry and the consumer.

Smaller companies may rightly regard the conduct of research projects with uncertain prospects of reward as a luxury. Some basic research, indeed, never results in any tangible payoff. But, with modest contributions, small companies can still have a part in the advance of basic research. They can join together with other companies on cooperative projects. They can support basic research through trade associations and technical societies. They can help research centers in universities and other nonprofit institutions. Arrangements are available in some instances whereby business firms can pay a fee to have access to work done by university researchers.

One way or another, it is up to private business firms to see that basic research moves forward. By doing so they will be laying the groundwork for the development of the new products and technology on which their growth, and the growth of the economy, depend.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nation-wide developments. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

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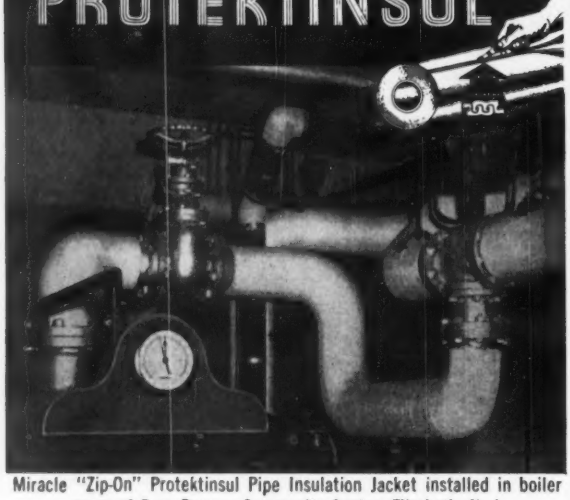

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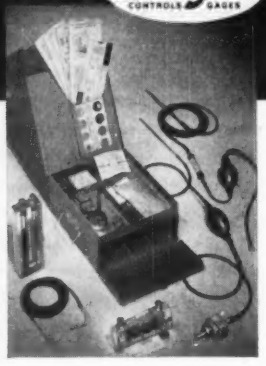

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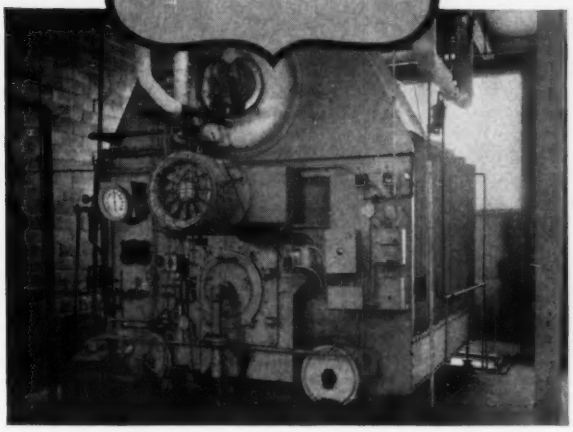

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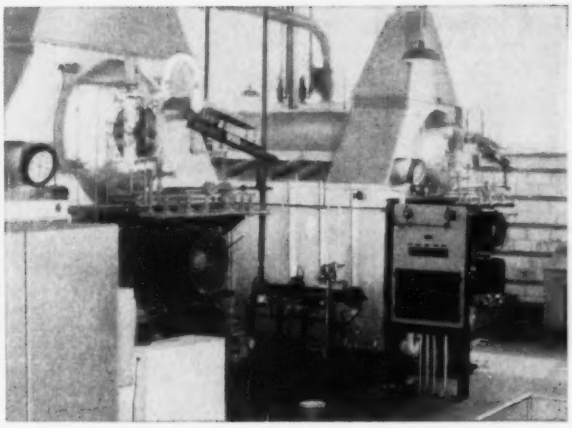

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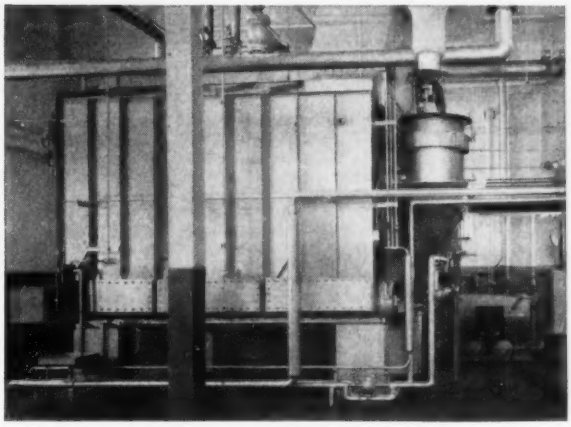

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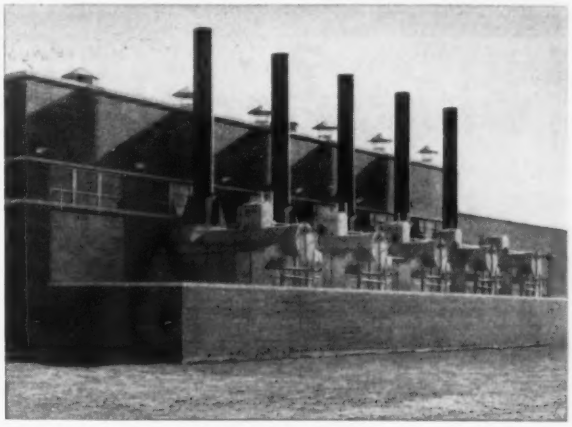

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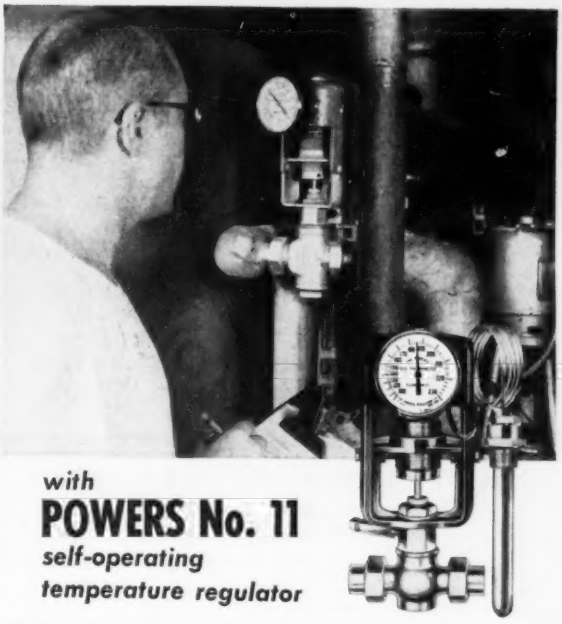

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- **AGE** to 38 years
- **EDUCATION** B.S. degree in Electrical Engineering
- **EXPERIENCE** Minimum 5 years development industrial electrical distribution designs and layous. Electrical materials experience helpful.

Initial salary commensurate with qualifications. *Send detailed resume covering personal data, experience summary and salary requirements to:*

CALIFORNIA TEXAS OIL CO., LTD.
380 Madison Ave., New York 17, N.Y.
Att'n: Personnel Relations Dept. (Service)

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

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Rebuilt HEMPHILL Guaranteed EQUIPMENT

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
3	750	G.E.	K	1	4600-120/240
1	750	G.E.	HT	3	4150Y-208/416
2	250	G.E.	H Pyranol	1	2400-4800-8320Y 120/240
3	250	West.		1	2300/4600-230/460
3	200	G.E.	H	1	7800-15600-220/440
1	150	Esler	OA	1	4160-240/480
2	3000	Maloney	TCR	3	7200/6600-4160/2400
5	50	G.E.	H	1	60-2400/4160-240/480
3	75	G.E.	H Form	1	60-2400-120/240
4	25	West.	Hypersil	1	2400/4160-120/240
3	15	West.	H Pyranol	1	6900/11950Y-120/240
6	15	Maloney	KL	1	2400/4160Y-120/240
1	50	Amer.	Absetol	3	4160-120/208Y

SYNCHRONOUS MOTORS

Qu	HP	Make	Speed	Type	Volts
1	100	G.E.	900	TS	2300
1	125	G.E.	600	TS	2300
1	125	F.M.	900		4800
1	150	G.E.	1800	TS	220/440
2	150	Allis-Ch.	360		2200
1	150	West.	900		220
1	300	Elec. Mch	720	TEFC	2300
1	500	West.	450	HR	440
1	1000	West.	360	Mill	2300/4150

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
1	15	G.E.	900	MT-542	440
1	25	G.E.	900	MT-526	440
1	60	G.E.	1800	MT	220
1	60	Ideal	900	AY	220
1	75	G.E.	600	IM	440
3	150	Allis-Ch.	1800	AY-RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
2	100	West.	1800	T.E.F.C. B.B.	220

SQUIRREL CAGE

Qu	HP	Make	Speed	Type	Volts
1	25	G.E.	1170	405TEFC	220/440
2	75	West.	1180	CS-607	440
1	100	G.E.	1775	KTP-543	440
1	40	Wagner	1200	CPI-445 TEFC B.B.	440
1	150	G.E.	720	KT-589	440
2	200	Cont.	1800	Exp. Proof	220/440
2	250	G.E.	1790	K T E F.C.	230
1	275	G.E.	1200	KT559BS	2200
1	300	G.E.	1800	K-4150V	new
1	400	Cent.	1200	N8068	2300

MOTOR GENERATOR SETS

Qu	K.W.	Make	Speed	Volts DC	Volts AC
3	60	E.M.	1200	125	220 v. Syn.
2	100	West.	1200	250	2300/4150Y Syn.
1	150	Cr. Wh.	600	125	220/440
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y S.R.
1	1000	West.	720	600	2300/4160Y

D.C. 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
1	75	C.W.	900	WP T.E.F.C.
1	125	G.E.	1700	RC
1	150	C.W.	900	WP T.E.F.C.
1	250	Allis Ch.	1750	FBL149BB

A.C. HOIST MOTORS

Qu	HP	Make	Type	Speed	Volts
1	25	G.E.	MTC	565	440
2	200	G.E.	TTC-5012	600	440

"FOR POWER"
J.L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK - LONGACRE 3-3727
PHONE NEW JERSEY - UNION 7-2600

WANTED

Complete power plants, turbo generators, Boilers, Condensers, Engine generators, Processing Plants and equipment.

PAUL OBERMAN

1910 Delmar St. Louis, Mo.

WANTED

750 KW Non-Condensing Turbo Generator, 125-140 Lbs. Initial Pressure, 15 Lbs. Back Pressure 3/60/440-480. Write to:

W-6301, POWER

Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

GET CASH NOW

for your new surplus motors, controls and transformers!

NEW MOTORS AVAILABLE:

Over 5,000 new motors, in stock, from ¼HP to 200 HP. Special low prices.

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AJAX ELECTRIC MOTOR CORP.
P.O. Box 262, Rochester, N.Y.
Long Distance Phone LD. 132

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

1—7500 KW 2400/4160 volt Condensing—400#—700° FTT. New 1949

1—3500 KW 2400/4160 volt Condensing—400#—700° FTT. New 1941

1—1000 KW—240/480 volt—130/250# Cond. Auto. Extraction—15#—New 1945

1—1000 KW 480 volts—225# Condensing—Auto. Extraction—20#

1—300 KW—480 volts—210# Condensing—Auto Extraction—40#

1—250 KW—240 volts—130#—Non-Cond. 10 12# Back pressure

TRANSFORMERS

1—500 KVA 4160/480 V. Pyranol 3 ph.

3—1667 KRH—13800/600 volts New 1948

A. LEE ELLIS CO., U.S. Machy. Bldg., 140 Federal St., Boston 10, Mass.

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EBASCO SERVICES INCORPORATED

APPARATUS EXCHANGE — Two Rector St., New York 6, N. Y.

FOR SALE — EXCEPTIONAL BARGAINS

Diesel Generator Units, 200 KW-1500 KW — Turbo Generators, 500 KW-10,000 KW Motor Generator Sets — Rotary Converters, Pumps, Boilers and Transformers.

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Power, published Monthly at New York, N. Y. for October 1, 1957.

1. The names and addresses of the publisher, editor, managing editor, and business manager are: Published by McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York 36, N. Y.; Editor, L. N. Rowley, 330 West 42nd Street, New York 36, N. Y.; Managing editor, J. J. O'Connor, 330 West 42nd Street, New York 36, N. Y.; Business manager, George A. Keates, 330 West 42nd Street, New York 36, N. Y.

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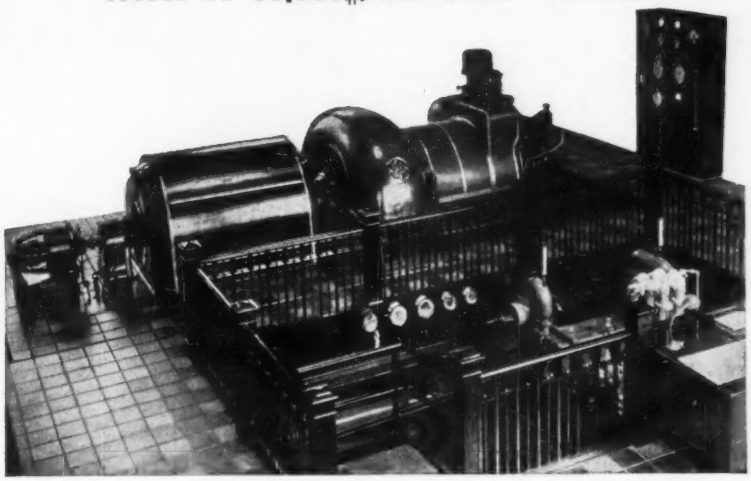
Sworn to and subscribed before me this 3rd day of September, 1957.

[SEAL] JANET A. HARTWICK

(My commission expires March 30, 1959)

MODERN 400 LB., 750 DEG. TURBINE-GENERATOR WITH A 66,000#/HR B&W BOILER



THE ABOVE 3750 KVA GENERAL ELECTRIC IS IN VERY GOOD CONDITION TURBINE #43103 GENERATOR #5406647 3/60/2300/4160V DIRECTLY CONNECTED EXCITER. COMPLETE WITH SURFACE CONDENSER, SWITCHBOARD, AND ALL AUXILIARIES.

ALSO IN STOCK

1—12,500 KW 350#, 600 DEG., 13,200V
1—10,000 KW 600#, 750 DEG., 12,000/13,200V
1— 2,500 KW 250/400# 13,800V, Automatic Ext. 50#

CHARLES WEAVER, INC.

19701 James Couzens Hwy. **Tel: BRoadway 3-1901** **Detroit 35, Michigan**

FOR SALE
DIESEL POWER PLANTS

2—Chicago Pneumatic, 6 cyl, dual fuel Diesel Engines, stationary type, circulating water cooled, bore 8", stroke 10½", type 68CP, can be operated natural gas or fuel, 180 HP @ 600 RPM, 225 HP @ 720 RPM, 250 HP @ 750 RPM, 270 HP @ 800 RPM, 290 HP @ 900 RPM. We can supply generators for these two units.

1—Buda Diesel, 8 cyl., 1200 RPM, Model 8-DC, 1290, bore 5⅜", stroke 6½", circulating water cooled, w/125 KVA AC Generator, 3 ph., 60 cyc., 1200 RPM, 240 volts and exciter. Mounted on steel base.

Price and further info. on request.

Philadelphia Transformer Co.
Box 566 **Dalton, Pa.**

FOR SALE
2812 KVA DIESEL GENERATOR UNIT

2812 KVA Crocker Wheeler generator, 3 phase, 60 cycle, 12,000/6900/4160/2400 volts direct connected to 3000 HP Busch-Sulzer (Nordberg) diesel engine, 10 cylinders, 240 RPM, complete with auxiliaries as in operation.

Used only 5 years—Excellent condition

INTERNATIONAL POWER MACHINERY COMPANY
1610 Union Commerce Building
Cleveland 14, Ohio

MISS POWER EQUIPMENT SAYS,
"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed New and Rebuilt Motors"

SQUIRREL CAGE MOTORS NEW AND GUARANTEED REBUILT

HP	Make	Type	Speed
350	A.C. S.B. Drip	ARWW-626	3600
300	G.E. S.B. Open	IK	1800
300	A.C. S.B. Open	AR-630	1800
300	G.E. S.B. Open	IK	900
300	G.E. S.B. Open	IK	720
300	West. S.B. Open	CS-1002	600
250	G.E. TEBB, 2300 V	K	1800
250	G.E. S.B. Open	KT	1800
250	F.M. B.B. Open	H	1800
250	G.E. S.B. Open 2200 V	IK-16	1200
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	F.M. B.B. Open	H-207	1800
200	G.E. TEBB	K	1800
200	A.C. S.B. Open	ARW-626	1800
200	G.E. S.B. Open	AT-556	1800
200	Cont. T.E.F.C. B.B.		1800
200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-158	1200
200	G.E. S.B. Open	KT-562	1200
200	G.E. S.B. Open 2200V	IK	1200
200	L.A. T.E.F.C. B.B.	JX-137	1200
200	G.E. S.B. Open	IK	900
200	West. S.S.B. Open	CS-876C	900
150	G.E. TEFCBB	K-6328	3600
150	G.E. TEFCB XP	K	3600
150	G.E. TEBB	K	1800
150	West. S.B. Open 2200 V	CS	1800
150	G.E. S.B. Open	IK	1800
150	West. S.S.B. Open	CS-772C	1200
150	G.E. S.B. Open	KT-558	900
150	Cont. T.E.F.C. B.B. New		900
150	G.E. B.B. Open	KT-558	900
150	G.E. S.B. Open	IK	720
150	Howell BB Open		720
125	G.E. TEFCBB	K	3600
125	West. B.B. Open	CS-761C	1800
125	West. S.S.B. Open New	CS-607	1800
125	G.E. S.B. Open	IK	1800
125	West. S.S.B. Open 2200 V	CS-607	1800
125	G.E. S.B. Open	KT-553	1200
125	G.E. S.B. Open	IK	1200
125	West. SSB Open	CS-764C	1200
125	G.E. S.B. Open	IK	900
125	G.E. S.B. Open	IK	720
125	G.E. S.B. Open	IK	600
100	A.C. S.B. Open	AR-5056	3600
100	Reliance B.B. Open	AA-504	3600
100	F.M. B.B. Open	H-121D	1800
100	G.E. S.B. Open	KT-345	1800
100	Burke B.B. Open	N-505	1800
100	A.C. S.B. Open 2200 V	ARX	1800
100	Century S.B. Open	SC-505	1800
100	G.E. S.B. Open	KT-347	1200
100	West. SSB Open	CS-607	1200
100	West. SSB Open	CS	1200
100	A.C. SB Open 2200 Volt	ARX	1800
100	A.C. TEFCBB	ARZ	1200
100	West. S.S.B. Open	CS-607	1200
100	West. S.S.B. Open	CS-774C	900
100	G.E. S.B. Open	IK	880

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NEW & USED Electrical Equipment
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SEND YOUR LIST TODAY!

FREE CATALOG. This is a partial listing. We are continually changing our stock, can fill your requirements at any time. Send for our free catalog. In Stock, fractional horsepower up to 500.

Large line of motors, Control Equipment, AC and DC Generators, MG sets and transformers. PHONE or WIRE us COLLECT

POWER EQUIPMENT CO.
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BELYEA-RE-NU-BILT

LARGE ELEC. POWER EQUIPMENT
SELECTED STOCK ITEMS
RE-NU-BILT—GUARANTEED—RE-NU-BILT
COMBINATION MILL DRIVES—
D.C. MOTORS WITH M.G. SETS & CONTROLS
PACKAGE DRIVES IN STOCK

1—2250 HP Elliott 300 V. 200/300 RPM DC Motor with 2400 KW GE MG Set. 300 V. DC 2300/4600 V. 450 RPM 3 ph. 60 cy.

1—1375 H.P. G.E., MCF, 415 V, 1200 RPM D.C. motor with 1100 KW G.E. MG Set 415 V. DC, 2300/4000 V. 720 RPM 3 ph 60 cycle.

1—1200 HP G.E. MPC, 600 V, D.C. Motor, 450 RPM, and 1000 KW, G.E. M-G Set, 600 volt DC with 1400 KP, .8 PF, Synch. Motor 13200/6600 volt, 3 ph. 60 cy.

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT	6900	1187
1	1100	F.M. BB	SF8068	4800/2400	1800
1	800	Whse.	CW	550	1776
1	750	G.E.	MT-573	2200	1190
1	700	Al. Ch.	D.P.	2300	500
1	600	Whse.	CW-432D-15	440	1778
1	500	Whse.	CW	550	850
1	350	Cr. Wh.	SIZE-718R	208/406	1765
1	350	G.E	IM-17A	440/2200	720
1	350	Whse.	CW-1039C C-15	440	720
1	250	Cr. Wh.	MT 424Y	4000	257
1	250	G.E.	SIZE-290	2,300	350
1	250	A.C		550	600
1	200	G.E.	IM	2200	580
2	200	G.E.	IM	2200	435
1	200	G.E	MT-557Y	2200	1760
2	200	Whse.	CW-800	2300	1775

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
1	580	G.E.	FT-559AY	2300	3600
1	550	Whse	CS-1115	2300	900
1	500	Whse.	CS-1216	2200	500
2	450	Whse.	CS-1420	2300/4150	354
1	400	G.E.	1K	2200	500
2	200	G.E.	KT-557	440	1800
2	200/150	Whse.	CS-963H	2300	1175/878
1	200	Whse.	CS-1002	2300/440	450
1	150	Whse.	CS	440	580
1	150	G.E.	1K-15A	2300	860

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4350	C.W.	3501-SL	13800/6900	514
1	3500	G.E.	TS-6487P	4600/2300/4000	360
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2000/2400	G.E.	450	250/300	2300/4600
2	2100/1750	G.E.	514	250/300	2300/4600
1	2000	G.E.	514	660	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1000	G.E.	900	240	4600
2	1000	G.E.	720	600	6600/13200
1	1000	G.E.	514	600	6600/13200
1	750	G.E.	720	275	6600/13200
1	750	G.E.	720	125/250	2300/4600
1	500	Whse.	900	125/250	440
3	300	G.E.	1200	250	2300
1	250	Whse.	1200	275	2300
1	200	El Mhy	1200	250	2300/4600
1	300	Whse.	1200	600	2300
1	200	Whse.		550	2300
1	200	G.E.	1200	250	550/2300
1	200	Cr. Wh.	1200	250	440
1	150	Whse.	1200	275	2300

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
1	3000	G.E.	OISC	3	33000x2300
1	1500	G.E.	F-TRANOL	3 auto	4000/4200/4400
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	FUR	1	4800x85/55
1	833	G.E.	OISC	1	13800x460
3	500	KUHL	OISC	1	13800x6900
3	500	KUHL	OISC	1	4800/2400x 240/480
3	200	Al. Ch	OISC	1	2300x230/460

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
1	5000	G.E	60/60/60	660/11000/6600
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/58.3	4400/2300
1	500	Al. Ch.	25/60	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	10000	Whse.	Condensing 650 lbs. 750° F.T.T. Surface Condenser Dir. Conn. Exciter.
2	3375	G.E.	650 lbs., 725°FTT, 150 lbs. G.B.P. non-condensing
1	2000	Al. Ch.	175 lbs., 5/30 lbs. G.B.P., non-condensing 3/60/480 volts.

BELYEA COMPANY INC.

43 Howell St., Jersey City 6, N. J.

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
450	440	Whse.	514
400(2)	2300	G.E.	900
400	4000/2300	Whse.	720
350	4000/2300	G.E.	720
300	2200	G.E.	450
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2200/440	G.E.	720
150	220/440	Whse.	720
125	2200	G.E.	600
100	440/220	G.E.	720

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
375	2200	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/460	G.E.	TS	720
300	2200/440	G.E.	TS	1200
150	440/220	G.E.	TS	720
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
500	2200/4000	Elliott	SC	1800
350	2300/440	G.E.	IE-K	1200
300(2)	2200	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
250	440/220	G.E.	KT	720
200	440/220	G.E.	KT	1800
200	2200	G.E.	KT	1800
200	440/220	G.E.	KT	720
200	2200/440	G.E.	IE-K	1200
150	440	Whse.	X-prf.	3600
150	2200	Al. Chal.	AR	1800
150	440/220	G.E.	KT	720
150	2200/440		KT	600
150	2200/440	G.E.	PT	1200
125(2)	2200/440	Whse.	X-proof	720
125	2200/440	G.E.	K	600
100(2)	4000/2300	L. Allis	OX	1200
75	2300/440	Whse.	TEFC	1200

A. C. GENERATORS

1—320 kva, 660 rpm, 2300/440/220 V., G.E.
1—360 kva, 900 rpm, 2200 V., Whse.
1—225 kva, 60 rpm, 220/440 V., G.E.
1—187 kva, 1200 rpm, 2200/440 V.. Whse.

CIRCUIT BREAKERS

9—1600 amp ITE, 3 pols, 600 V.
6—FKB-155-28, 600 amp., 15,000 V. G.E.
1—400 Amp., Condit. 3P, 25 KV outdoor
1—400 Amp. R. Smith, 3 P 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	1800
200	230	Cr. Wh.	CMC	1200
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	850

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	440	Syn.	250
125	G.E.	440/220	Sq. Ca.	125
125	G.E.	440	Sq. Ca.	250/125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al. Ch., 2400/4160Y—600 volts, 3 ph
3—500 kva, G.E., 13,800—300 V.
3—333 kva, G.E., 13,800—2300 V.
2—300 kva, G.E., 4150—240 V., 3 ph., Pyr.
1—200 kva, Al. Ch., 6900—220 V., 3 ph.
3—200 kva, Whse., 4600/2300—230/115 V.
1—200 kva, G.E., 2400—120/240 V., Pyr.
3—200 kva, Mol., 13,800—2300 V.
3—150 kva, Al. Ch. 2400—220 V.
3—150 kva, Al. Ch. 440-220 V., dry New
3—150 kva, G.E., 13,200—2300 V.
3—100 kva, G.E., 2400—120/240 V., Pyr.
6— 50 kva, G.E., 13800—120/240 V.

only partial listing

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HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

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100 KW to 1500 KW
Diesel Generator Sets • Stationary • Portable • Mobile Motors and Generators

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Two 200 H.P. James Leffel Scotch Marine Boilers In Good Condition. One has a combination Gas and Oil Burner, Other one has an Oil Burner complete with Stacks. **For further information contact P. E. MYERS, CONSOLIDATED PRODUCTS Division of National Dairy Products Corp., Danville, Illinois.**

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400 HP 160 LSP Springfield WT Boiler
5 Ton 70' Span OET Crane w/motors
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FEED PUMP

Size LC-315J Turbine & Pump 4650 RPM—540 PSI Steam 15 PSI Back Pressure—Pump 675 GPM at 725 PSI—New, Unused, Sacrifice Price.

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NEW ADVERTISEMENTS

received by Nov. 11th will appear in the December issue subject to space limitations.

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138 CFM 100 psi 7x7 Ing.—ESI
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399 CFM (actual) 100 psi Fuller C80-80H
420 CFM 49 psi 12x9 Ing. ES—Oil-Less
465 CFM 100 psi 12x11 Penn 3AT
528 CFM 100 psi 14x12 IR-CP—Penn
585 CFM 100 psi 15—9¼x12 IR—XRE 3-60-4160
590 CFM 100 psi 13½—8x8 Penn DE2
676 CFM 100 psi 15—9¼x12 Ing. XRB
686 CFM 100 psi 14x13 Worth HB
868 CFM 100 psi 17—10x12 Chic. OCE 3-60-440
870 CFM 125 psi 17—10½x12 Ing. XRE 3-60-220
877 CFM 100 psi 17—10½x14 Ing. XRB
1007 CFM 100 psi 19—11x2 Chic. OCB
1060 CFM 60 psi—12-12x7 Chic YDE 3-60-4000
7950 CFM 200 psi 33—7¾x27 Ing. PRE2 4C
5748 CFM 50 psi 29—29x21 Ing. PRE1 3-60-2300
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18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.
Will sell turbines separately if desired. *Price reasonable.*
Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

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FOR SALE—100 KW ALLIS CHALMERS—250v DC, 900 RPM, compound, dir. conn. to 150 HP Sq. Cage Motor, 3/60/440 volts complete with GE Manual Compensator and DC Panel.

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Handle more cars better—cost less to install and maintain. Foster stocks all Rail Sections 12# thru 175#, Switch Material and Track Accessories.

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GUARANTEED REBUILT POWER EQUIPMENT

HERE'S A WIDE SELECTION FROM OUR GIANT STOCK

MOTORS SLIP RING

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	MAKE	TYPE	RPM
1200	*Al-Ch.	ANY	1800
600	*G.E.	M-6345S	1800
500	G.E.	M-6345Z	1200
250	Al-Ch.	ART-626J	1800
250	*G.E.	I-M-17A-10	720
200	G.E.	I-M-16	600
200	*West.	CW-950A	514
150	Cr.-Wh.	50R	1800
150	West.	CW-874C	720
150	Al-Ch.	ANY	600
125	G.E.	I-M-15A	600
125	*G.E.	I-M-15A	600
100	G.E.	I-M-E13A-4	1800
100	G.E.	I-M-14	900
100	*G.E.	I-M	720
100	G.E.	I-M-15A	450
75	North-W	KW-50	1800
75	G.E.	MT-347-6	1200
75	G.E.	I-M-13	1200
75	G.E.	MT-356-8-75	900
75	Al-Ch.	ANY-33C	720
75	G.E.	I-M-10	720
75	G.E.	MT-352-10	720
75	G.E.	I-M-14-12	600
75	West.	CI-756A	600
60	West.	CW-FB-600C	1800
60	Al-Ch.	ARY-423C	1200
60	*G.E.	MT-356-6	1200
60	*West.	CW-762C	900
50	*G.E.	MT-536-8	1200
50	G.E.	MT-536	1200
50	West.	CW-636A	1200
50	G.E.	I-M-8	900
50	Al-Ch.	ARY-223C	900
50	G.E.	MT-346-10	720
50	G.E.	MT-546-10	720
50	West.	CW-758	720
50	Al-Ch.	ANY-26F	600
40	G.E.	I-M-11A	1800
40	G.E.	MT-336-6	1200
40	G.E.	MT-532-6	1200

MOTORS SLIP RING
Crane and hoist

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	MAKE	TYPE	RPM
100	G.E.	MTC-5546-8	900
80	G.E.	MTC-5552	600
50	G.E.	HIC	600
35	G.E.	MTC-5536	600
25	West.	CI-636-A	720
15	G.E.	ITC-5009	900
11	West.	CI-E464-A	900
10	P & H	BW-6	1800
5	North-W	WRC	1200
5	P & H	BW-6	1200
5	G.E.	MTC-5730	1800

SYNCHRONOUS MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	MAKE	TYPE	PF	RPM
1420	West.	HG	0.7	900
300	G.E.	ATI-6-285M	0.8	1200
300	*Ideal	SMM	0.8	257
275	*G.E.	ATI	1.0	450
250	Al-Ch.		1.0	1200
225	Elec. Machy		1.0	360
225	G.E.	TS-6244	1.0	300
200	G.E.	TS-7559	1.0	1800
190	Elec. Machy		1.0	720
150	Al-Ch.	SYN	0.8	1200
150	*Elec. Machy		0.8	1200
150	*West.	HR	1.0	300
125	*G.E.	TS-7641	1.0	514
125	*G.E.	TS-6214	1.0	277
125	Elec. Machy			900
125	Compton		0.9	900
115	Elec. Machy		1.0	240

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2200 volts or higher)

HP	MAKE	TYPE	RPM
1250	*Al-Ch.	ANX	3600
600	*G.E.	K-63458	1200
500	*G.E.	K163458	1200
350	*G.E.	KT-559A-4	1800
300	*G.E.	K-63447	1200
250	West.	CS-875-S	1800
250	G.E.	KT-559-4	1800
250	G.E.	KT-559-S	1800
250	West.	CS-8120S	1800
250	Brook	RS-28	1200
250	G.E.	I-K	600
200	*G.E.	FT-549T-2	3600
200	*G.E.	I-K-13B	1800
200	Brook	R-27	1200
200	West.	CS-930A	900
200	*Al-Ch.		900
200	G.E.	KF-564S	720
200	*Al-Ch.	AN-37G	720
200	Al-Ch.	ARWWT	600
200	West.	CS-FR-1010	600
150	Cr.-Wh.	SC-149CQ	3600
150	G.E.	I-E-13B-6	1200
150	*Al-Ch.	AN-30F1	1200
150	G.E.	I-8-FR-13	900
150	*West.	CS	600
125	*West.	CS-771-1S	1800
125	West.	CS-761C	1800
125	Cr.-Wh.	50R	1200
125	G.E.	K-558	900
125	Al-Ch.	AN	514
100	West.	CS-507S	3600
100	*West.	CS-760A	1800
100	*G.E.	FT-542Z	1800
100	G.E.	FTRP-543	1800
100	West.	CS-760D	1200
100	Al-Ch.	AW-23D56	1200
100	G.E.	I-K-6	1200
100	G.E.	KT-553	1200
100	Al-Ch.	ARZ-826FS	1200
100	*G.E.	KT-556-8	900
75	*Al-Ch.	AR-445S	3600
75	G.E.	FT-529-2	3600
75	G.E.	FT-529Y-2	3600
75	Al-Ch.	APZ-5044	1800
75	G.E.	FT-537-4	1800
75	G.E.	KG-445	1800
75	*Al-Ch.	AR-505S	1800
75	G.E.	KT-546-S	1200
75	*G.E.	KT-542	1200
75	*West.	CS-664C	1200
75	*West.	CS-762	900
75	Al-Ch.	AR-226C	900
75	G.E.	I-10-K-14	720
75	G.E.	I-14-12	600
60	G.E.	KT-337	1800
60	Al-Ch.	APZ-504U	1200
60	G.E.	KT-343-8	1200
60	G.E.	K-505	1200
60	*G.E.	EF-505	1200
60	Al-Ch.	ART-505	1200
60	Al-Ch.	AR-823D	900
60	*West.	CS-762B	900
60	G.E.	Y-8-K	900
60	G.E.	KT-346-8	900

PLATERS

AMPS	MAKE	VOLTS
7500/3750	Elec. Prod.	6/12-220/440
7500/3750	Chandy.	12/24-220/440
6000/3000	Chandy.	12/24-220/440
6000/3000	Chandy.	8/16-220/440
5000/2500	Optimus	6/12-220/440
5000/2500	Chandy.	8/16-220/440
1500/750	Chandy.	12/24-220/440
1000/500	Chandy.	12/24-220/440

M. G. SETS

KW	MAKE	AC	DC
500	West.	440	220/110
400	Al-Ch.	2300	120/240

M. G. SETS (Cont.)

300	West.	2300	250
250	G.E.	440	250
200	G.E.	2300	250/275
200	West.	2200/4000	250
170	G.E.	220	125
150	G.E.	514	250/275
150	West.	2300/440	125/250
150	Al-Ch.	2200	250/275
125	G.E.	5000	250
125	Cr-Wh.	4150	125
100	G.E.	440	125
100	G.E.	2300	250
100	G.E.	1200	230
100	G.E.	2300/4000	250/275
100	West.	2300/4000	250/275
100	Al-Ch.	2200	250
100	Elec. Mchy.	220	125
90	G.E.	220	125
60	G.E.	220	230/250
60	G.E.	440	230/250
50	West.	220	120/125
50	Ideal	2200/550	240/250
35	West.	2300	150
30	G.E.	2200/440	125
25	West.	220	300
20	G.E.	220	250
20	Elec. Pdts.	220/440	400
20	Bogue-G.E.	220/440	125
15	Ideal	440	125

MOTORS
D.C. 230 V.

Constant Speed

HP	MAKE	TYPE	RPM
200	West.	SK-281	600
175	G.E.	KLC-11	750
100	G.E.	RC-34	2500
100	G.E.	RC-19	600
75	Roth		1800

Variable Speed

250	West.	SK-220	450/600
200	Rel.	FR-1400T	850/1200
150	G.E.	MCF	380/100
100	C.W.	CD-135-4	758/1500
100	G.E.	MPC-6	400/800
50	Al-Ch.	E-146	850/1275
35	G.E.	CD-115	500/1500
35	West.	SK-15D	350/700
30/40	G.E.	CD-123	400/1600
25/30	G.E.	RF-12	500/1600

now

Westinghouse

Single Step, Primary Resistance Type Magnetic SQUIRREL CAGE MOTOR STARTERS Three Phase, 60 Cycle, Class 11-400

Qty	HP	Volts	List Price	Our Price*
			Size 2	
1	10	220	$ 420.00	$ 147.00
3	15	220	450.00	157.00
1	20	440	484.00	169.00
1	25	440	504.00	175.00
			Size 3	
2	20	220	660.00	210.00
2	40	440	660.00	231.00
2	50	440	684.00	239.00
			Size 5	
3	60	220	2,022.00	925.00
5	75	220	2,022.00	925.00
4	100	220	2,178.00	995.00
3	125	440	2,094.00	1,075.00
9	150	440	2,094.00	1,075.00
8	200	440	2,372.00	1,175.00

*Discounts available to dealers and large users.

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CHICAGO *Electric Co.*

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BARGAIN OPPORTUNITY

600 HP, 720 RPM, General Motors Corporation-Electro Motive Division Diesel engine, Model 567, 8 cylinders, 8½" bore, 10" stroke direct connected to a:

500 KVA—400 KW at 80% PF, 720 RPM, 3 phase 60 cycle, 480 volt Westinghouse alternating current generator. Complete installation. Radiator cooled, equivalent to new.

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2 B&W #144 COAL PULVERIZERS—Like New Ball Mills (vertical type) Driven By 100 HP, 2300V Motors.

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Government Surplus SAVE OVER 75%

NEW, NEVER USED, NEVER ERECTED, AVAILABLE IMMEDIATELY

121,650 Lbs.

1 Foster Wheeler
Express Type, 3-drum, with integral superheater separately fired.
Includes boiler, superheater, economizer, 7 fuel oil burners, soot blowers.
Pressure 634 psi, temp 850° F.
Furnace Vol: boiler 310 cu. ft., superh. 247 cu. ft.

60,000 Lbs.

10 Babcock Wilcox
3 Foster Wheeler
"D" Type, 2-drum, with integral superheater fired between boiler tube bank.
Includes boiler, superheater, economizer, 3 fuel oil burners, soot blowers.
Pressure 475 psi, temp 750°F.
Furnace Vol: 330 Cu. Ft.

55,000 Lbs.

1 Wickes Boiler
"A" Type, 3 drum.
Includes boiler, 3 oil burners, soot blowers.
Pressure 250 psi.
Furnace Vol: 420 Cu. Ft.

We own and stock these boilers. Inspection Invited at Utica, N.Y. Subject to prior sales.

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MODERN SLOW SPEED

DIESEL ELECTRIC GENERATING SET

OFFERED AT CONSIDERABLE SAVING

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8B5
100 KW
600 RPM
3/60/480
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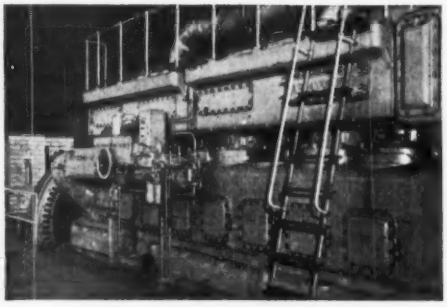
Other Sets from 20 KW to 1200 KW



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Other Sets from 20 KW to 1200 KW

FAIRBANKS MORSE MODEL 33F16
1125 KW 300 RPM 3/60/480V

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DIESEL DIVISION

DIESEL GENERATOR SETS

4—Fairbanks Morse 1600 HP, 720 RPM, 1136 KW F.M. 3/60/2400 generators, 125 V. exciters.

1—Fairbanks Morse 300 HP, 300 RPM, 250 KVA F.M. 3/60/2400 generator, 7½ KW exciter.

1—Baldwin DeLavergne 1140 HP 6 cyl. 4 cycle, 200 RPM, 1000 KVA Elliott 3/60/2400 generator. 20 KW exciter.

Complete plant installation with all accessories. Priced attractively.

WHISLER EQUIPMENT CO.
611 Olive St. St. Louis 1, Mo.

TURBO-GENERATOR

3000 KW Whse. Cond. 3/60/2400 V.
3600 RPM 400 PSIG 750°
3000 KW Al.Ch. Cond. 3/60/600 V.
3600 RPM 400 PSIG 750°
2000 KW Whse. Cond. 3/60/2400/4150
3600 RPM 240/400 PSIG 750°
1500 KW Ell. Cond. 3/60/2400/4150 V.
3600 RPM 400 PSIG 750°
300 KW G.E. Non-C. 3/60/480 V.
3600 RPM 150 PSIG 5#BP

Full line power equipment

BREW, WOLTMAN & CO., INC.
50 Church St., New York 7, N. Y.

G.E. STEAM TURBINE GENERATORS OFFERED AT A SMALL FRACTION OF REPLACEMENT COST

(Not an actual photo but similar)

375 lb. throttle pressure, single & double automatic extraction—non-condensing 3 phase 60 cycle 480 volts.

1—1500 KW extraction, 150 lbs. exhaust 85.
1—2000 KW extraction, 150 & 85 lbs. exhaust 10 lbs.
1—2500 KW extraction, 150 & 85 lbs. exhaust 10 lbs.

All complete with breakers, voltage regulators and miscell. accessories. Ideal for Paper, Sugar & Chemical Industries. Mfd. in 1933.

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TRANSFORMERS

3—500 KVA 1/60/2300-4000Y to 230/460 Westinghouse OISC, with taps
3—833 KVA, 1/60/34500/460 Moloney OISC, with taps
2—250 KVA 1/60/2400-240/480 Moloney, OISC, type YC, with taps
1—300 KVA, 3/60/4160-240 Wagner, type HPB-ITE Unit Substation, Outdoor
1—200 KVA, 3/60/4160-240 Wagner, Type RPB-ITE Unit Substation, Outdoor

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For Surplus Electrical Equipment

BENSON-WILIMZIG, INC.
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COMPLETE SWITCHBOARD
DESIGN & CONSTRUCTION
USED & REBUILT EQUIPMENT
DIESEL SALES & SERVICE
GENERATORS—GAS OR DIESEL

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MODERN POWER PLANT

1875 KVA WORTHINGTON MOORE TURBINE 400 PSI, 700°F Condensing, driving 2300 Volt CROCKER WHEELER GENERATOR 25000#/Hr. 450 PSI, 738°F, Coal Fired BOILER; includes all auxiliaries, controls, 25 Ton powerhouse crane and coal handling facilities.

(Will sell boiler or generator set separately)

3 PPM VAPOR EVAPORATOR

GRAHAM 8700 to 15,000 lbs./hr. complete with all auxiliaries. New 1954.

BOILERS

400 HP B.&W. (Sterling) 160 PSI Oil/Gas fired, ASME, New 1947. (2)

Comb. Engrs. M-2 Package 175 HP—275 PSI oil fired (3)

PARTIAL LISTING ONLY
SEND US YOUR INQUIRIES

GENERATOR SETS

500 KVA RATHBUN JONES Gas Engine Set 3/60/2300V

540 KW — DC — 120/240 Volts Steam Turbine 200 PSI

125 KW G.E. 2300 V 3/60/514 RPM WORTHINGTON Gas Engine 5 KW Exciter and Panelboard

SYNCHRONOUS MOTOR

700 HP, 4150/2400V, 514 RPM.

HEAT & POWER Co., Inc.

POWER EQUIPMENT DIVISION

60 EAST 42nd ST. NEW YORK 17, N.Y. MUrray Hill 7-5280

518 THOMPSON BLDG. TULSA 3, OKLAHOMA Diamond 3-4890

look for the WAGNER GREEN TAG CERTIFICATION

It's your guarantee that the equipment you buy is as perfect in workmanship as the day it left the factory.

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	G.E. dynamom.	TLC	250	1150/2500
200	G.E. dynamom.	TLC-74	250	1150/3500
170	Cr. Wh.	151-H	230	500
150	Whse.	SK-184	230	850
100	Reliance	651-T	550	1000/1800
100	Elliott b.b. T.E.	JH-FE	230	1150
75	Reliance (3)	985-T	230	450/1200
60	G.E. TEFC b b.	CD-135	230	1150
50	Century	DN-514	230	1150/1750
50	Gen. Elec.	CD-95	230	1800
50	Star b.b.	SQ-92	230	880
50	G.E.	CD-125	230	400/1300
50	G.E.	RF-16	230	250/1000
40	G.E. (2)	CD-93	230	1750
30	G.E.	CD-113	230	500/1500

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	2200 AC	250 DC
200	Whse.*	220/440 AC	85 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Whse.	2300 AC	250 DC
200	G.E.	2200/440 AC	600 DC
175	Gen. Elec.	220/440 AC	250 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	Gen. Elec.*(2)	220/440 AC	250 DC
75	Gen. Elec.	220/440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Allis Ch.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Cr. Wh. b.b. (2)	220/440 AC	250 DC
25	Whse.	220/440 AC	250 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	G.E.	RC	600	1150
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	850
125	Gen. Elec.	CD	250	1150
100	Allis Ch.	E	125	1200
100	Reliance	651-T	600	1200
75	Gen. Elec.	CD-123	125/250	1200
60	Allis Ch. (3)	E-146	250	1500
60	Ideal	D	125	1150
50	Star b.b.	SQ	250	900
25	Whse.	SK-103	250	1750
20	Ideal	D-405	125	1150

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
500	G.E.	Sq. Cage	4000	1800
500	Whse.	Slipring	2200	450
400	Whse. (2)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
400	Whse.	Sq. Cage	2300	900
400	G.E. (2)	Slipring	440	900
400	G.E.	Slipring	2300	514
350	G.E.	Sq. Cage	2200	1800
350	Cont. b.b.	Slipring	2300	900
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/4000	600
300	G.E.	Slipring	2200/440	600
300	G.E. (2)	Synch.	2200/440	360
300	Whse.	Sq. Cage	2200/440	720
300	Whse.	Synch.	440	1200
300	G.E.	Slipring	440	450
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Slipring	220/440	720
250	Whse.	Slipring	440	1200
250	G.E.	Sq. Cage	2200	1800
225	G.E.	Synch.	220/440	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Allis Ch.	Slipring	2200/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G.E.	Sq. Cage	440	600
175	G.E. (2)	Synch.	220/440	720
150	G.E. (4)	Slipring	2200/440	600
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E.	Slip Ring	220/440	450
150	G.E. (2)	Sq. Cage	2200/440	1800
150	Allis Ch. b.b.	Sq. Cage	2200/440	720
150	L. Allis b.b.	Sq.Cage	440	3600
125	G.E. TEFC	Sq. Cage	2200	3600
125	Ideal	Slipring	4000/2200	900
125	Allis Ch.	Sq. Cage	2200	900
100	G.E. (2)	Slipring	2200/440	720
100	Al. Ch. TEFC	Sq. Cage	2200/440	720
100	Smith b.b. (6)	Sq. Cage	220/440	1800

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Arthur Wagner Co. Certified

MO nroe 6-7409

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CHICAGO 7, ILLINOIS

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220 VOLT A.C. OPERATION

Meters — circuit breaker — transfer switches — rheostat — disconnect switch — voltage regulator — reverse current relay. Free standing dead front modern type. Necessary components for parallel operations.

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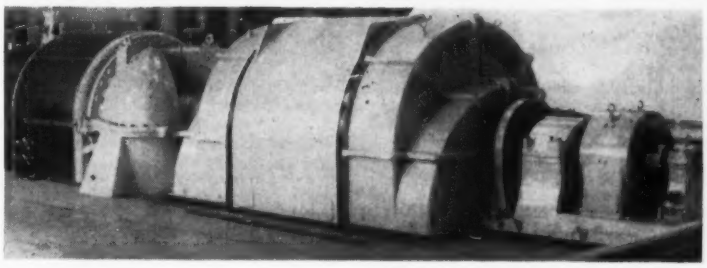

Consisting of 8000 KW, 3600 RPM, 11,500 Volt 3 Phase, 60 Cycle, 450 PSI Parsons Steam Turbo Generator complete with all auxiliaries, modern switch gear and transformers. 90,000 lb. per hour, 450 PSI, Babcock and Wilcox Boiler complete with all auxiliaries. Plant was used as stand-by and is in new condition. Can be inspected any time. *Immediate delivery.*

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GRANVILLE ISLAND • PACIFIC 3487 • VANCOUVER, B. C.

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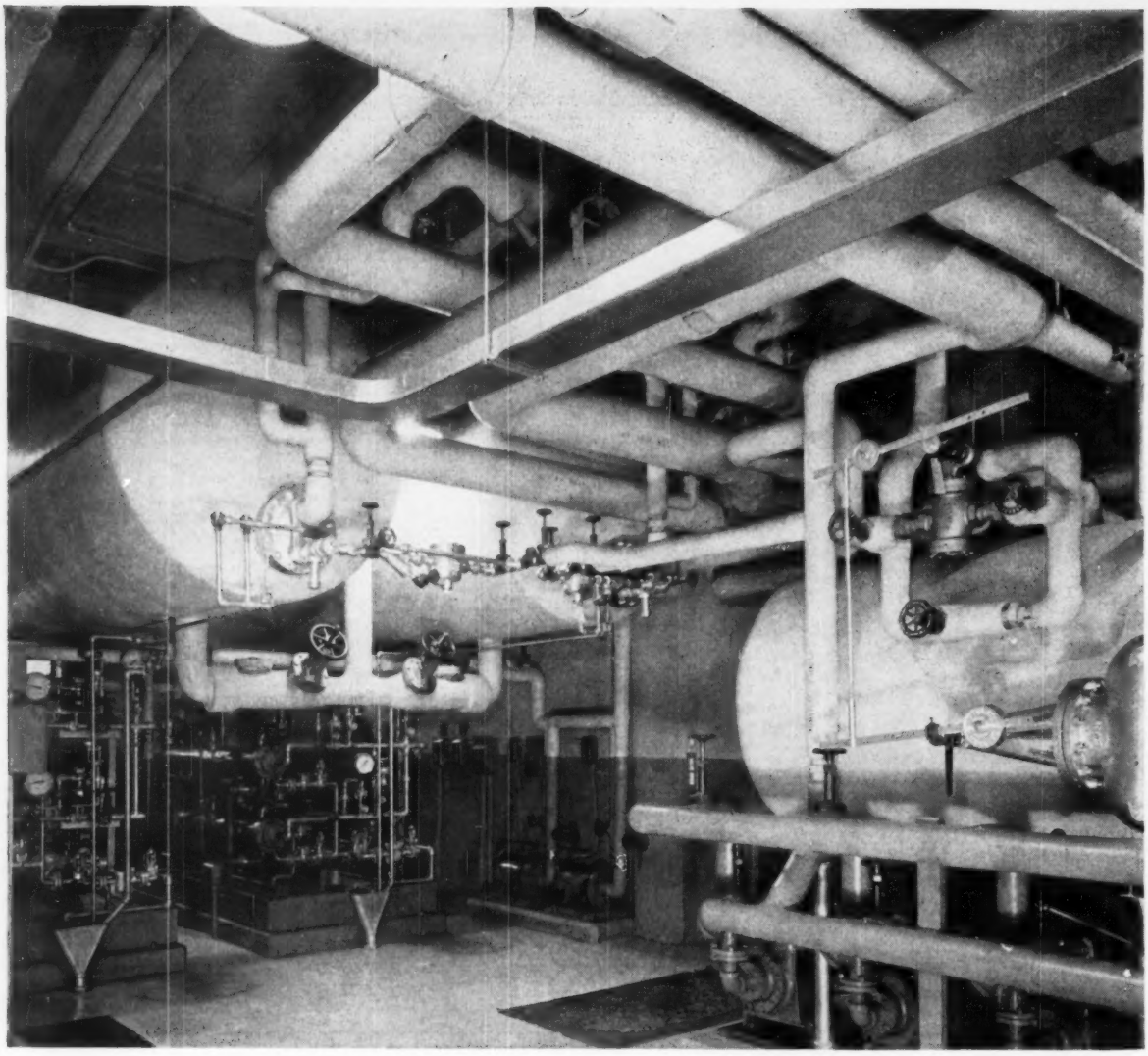

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DIAMOND POWER

means

People

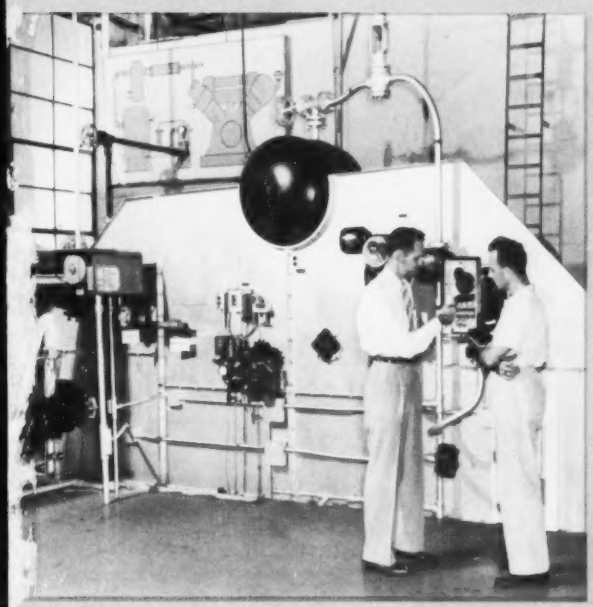
Of these three, people are most important. All industrial progress depends upon people with specialized training and long experience . . . working under optimum conditions.

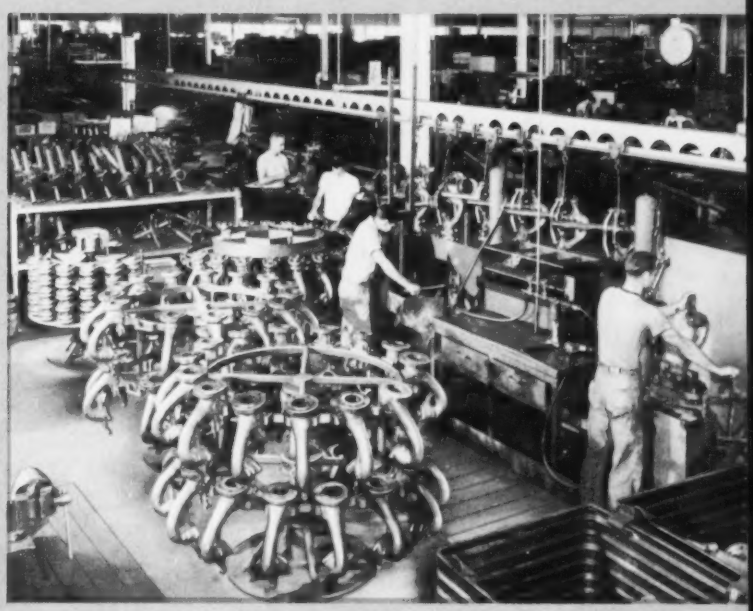
Plant

People accomplish most when they have the best in research, development and manufacturing facilities. Diamond provides the most modern facilities available.

Products

Our continuous program for product improvement and manufacturing betterment assures the most advanced equipment for boiler cleaning and water level indicating.





REALISTIC TRAINING

We make every effort to provide our personnel with training that is realistic and thorough. This simulated boiler in the Diamond laboratory is an example of the methods used. In it the various types of Diamond Blowers react in the same way as in service . . . may be studied intensively and conveniently.

MODERN FACILITIES

Our plant and equipment are thoroughly modern . . . the most advanced production methods are employed. Maximum use is made of materials handling and other time-saving equipment. This picture illustrates part of the automatic valved soot blower production line, showing various testing and assembly operations.

Diamond

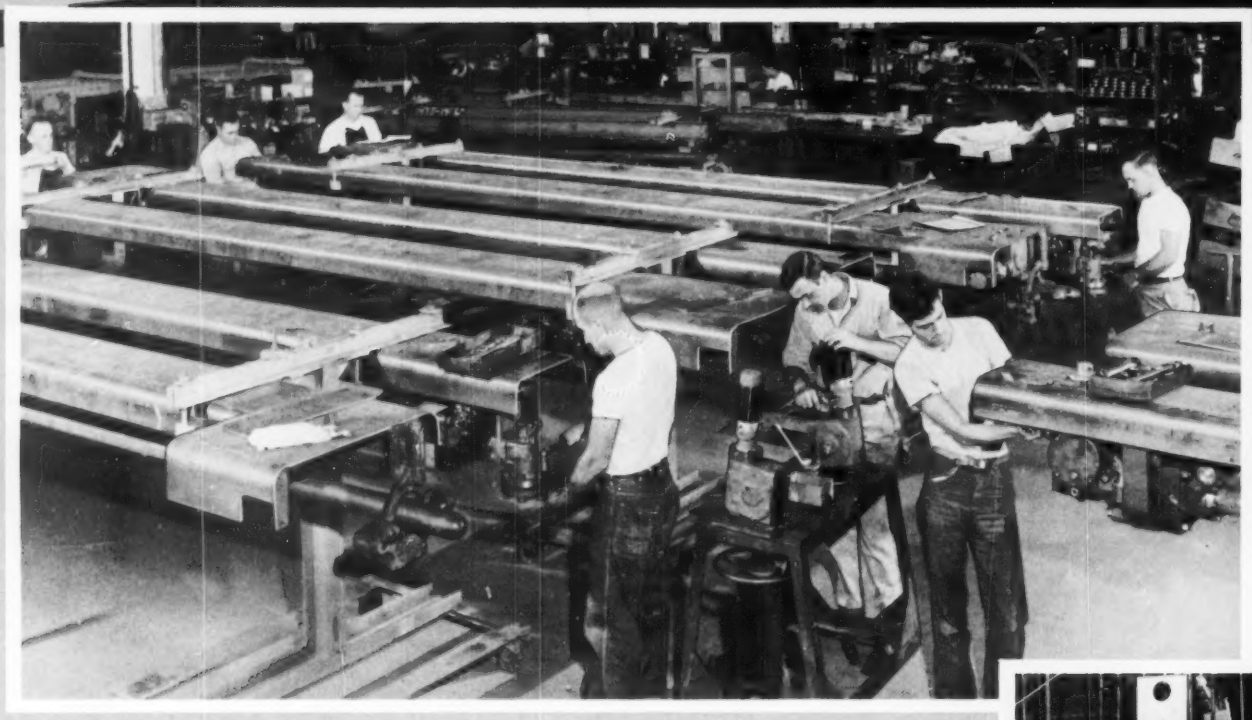
DIAMOND POWER SPECIALTY CORPORATION

LANCASTER, OHIO

Diamond Specialty Limited, Windsor, Ontario

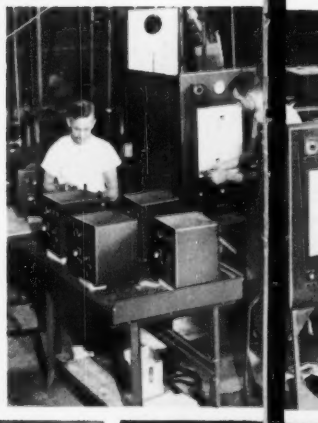
DIAMOND POWER PEOPLE .

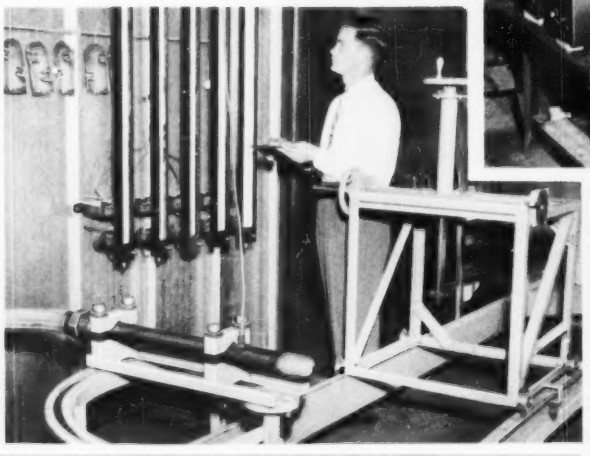
Contribute to the M o

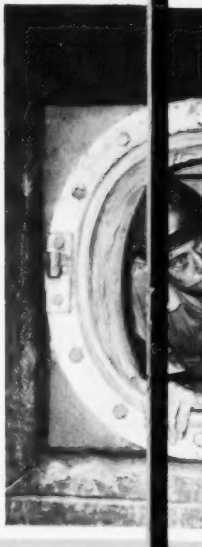


ASSEMBLING THE BIG BOYS

Here is the final assembly for Diamond Series 300 IK Long Retracting Blowers. Even though large and designed to suit individual boilers not identical in all respects, these blowers are fabricated and assembled with the aid of advanced production line techniques.







145 YEARS EXPERIENCE

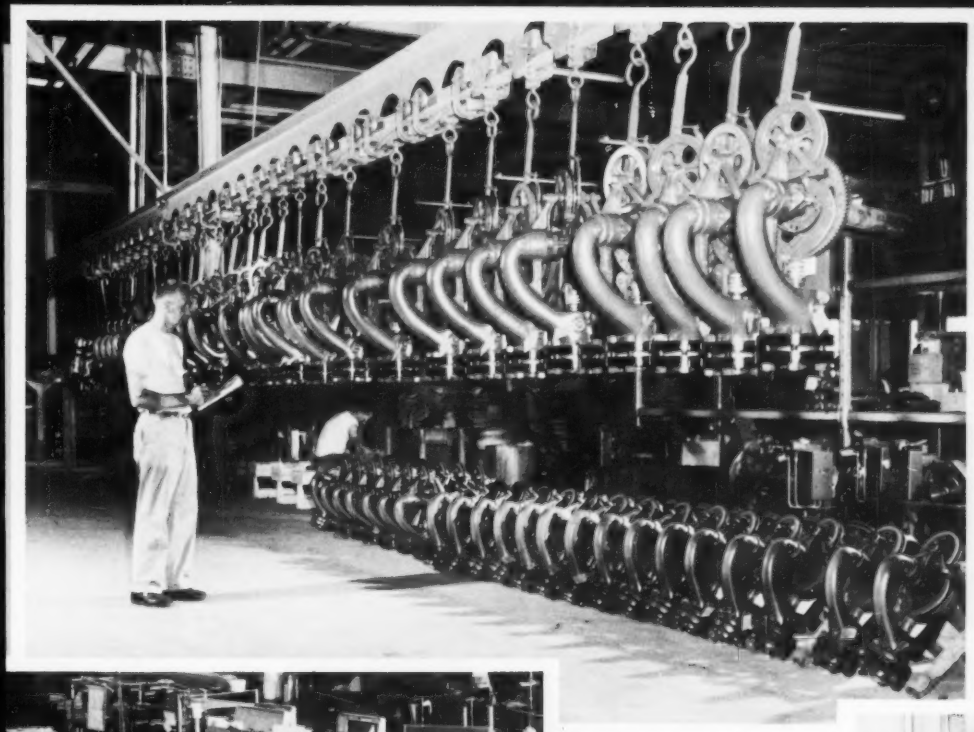
We have many people with valuable and long experience. Here are four with an aggregate of 145 years. As might be expected they are in key positions . . . Contract Supervisors. Theirs is the vital task of establishing the application engineering requirements of each job and following it to completion.

THE BEST IS NEVER GOOD ENOUGH

Diamond researchers are never satisfied. During the past several years, intensive research into blower nozzle design evolved and tested more than 50 patterns. Although recent designs show greatly improved efficiency and economy, research continues in an effort to gain even more.

. . . PLANT . . . and PRODUCTS

ore Efficient Operation of Modern Steam Power Plants

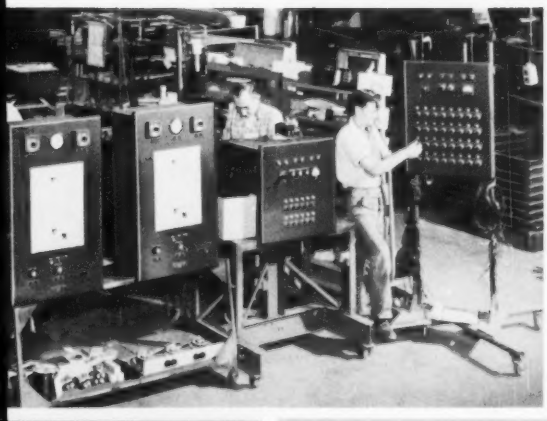


QUALITY CONTROL

From receipt of raw materials to shipment of finished product, every Diamond operation is under close quality control. Here G9B Blowers get their final inspection.

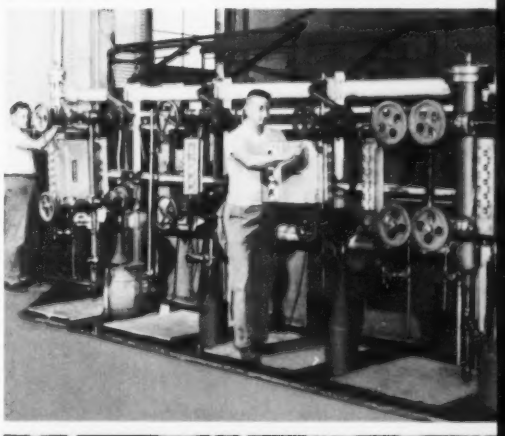
TESTING UNDER OPERATING CONDITIONS

Diamond Gauges and Water Columns are tested under actual operating steam pressures. A test boiler provides steam at pressures up to 2500 psi. Continuous vision and Multi-Port Bi-Color gauges are accurately adjusted for field conditions.



SELECTROMATIC PANELS

Assembly of Selectromatic Panels that provide the means for programming boiler cleaning systems. To achieve most effective system integration, Diamond believes in designing and building all important components wherever practical and economical.

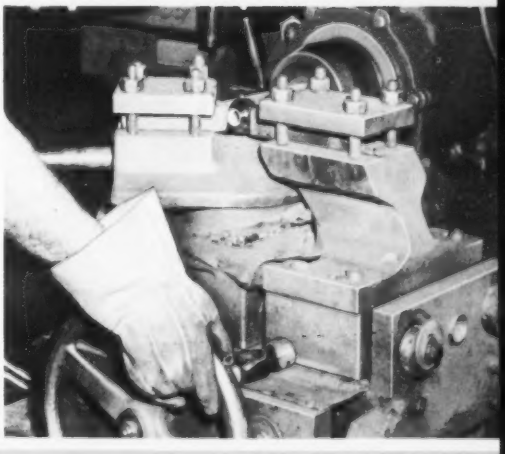


UNIQUE DIAMOND SERVICE POLICY

Every installation of Diamond Blowers in stationary water tube boilers is periodically inspected and adjusted by one of 32 Resident Field Service Engineers . . . unsolicited and without charge. This policy, in force for forty years, has contributed substantially to improved boiler availability and efficiency.

SPECIAL MACHINERY

The efficient manufacture of Diamond products has necessitated the development of considerable special machinery. Here is a heavy duty spinning machine for forge-closing the ends of blower elements and lance nozzles.



DIAMOND POWER

PEOPLE...PLANT...and PRODUCTS
LOOK TO THE FUTURE

TODAY AND TOMORROW

Above is shown the modern Diamond plant at Lancaster, Ohio. In addition to the expansion of manufacturing facilities, the office building is being enlarged to provide for increased engineering, service, and advanced data processing facilities . . . all to improve our present performance and to meet the future growth pattern of the power and process industries.

OPERATION FUTURE

Here we are conducting extensive research on shot cleaning . . . a new concept of cleaning for certain down-pass convection heating surfaces. Shot cleaning shows much promise in several early installations.

LITHO IN U. S. A.

ALL THIS . . . And History Too

History of a firm is of importance only if it is an inspiration and foundation for achievements now and in the future. No company can hope to serve its customers to their best advantage if it spends much time glorying in the past. Diamond Power is proud of its history, but we are far more concerned with today's performance and tomorrow's planning.

The company was founded 54 years ago; its first products were damper controls and tube cleaners. A little later came a soot blower for fire tube boilers . . . then the independent-valve blower for use on the small water tube boilers of that day.

In 1915, we inaugurated the program of research and development that has continued ever since. Among its accomplishments not mentioned elsewhere are: valve-in-head construction, dialoy elements, poppet type valves, the first retracting blower, air-puff blowers, loose-window water gauges (Bi-Color and Multi-Port), and the "Utiliscope" industrial TV system.

During all this time, Diamond Products have been continually improved to meet the advancing needs of growing industry by mechanization and automation. At present we are testing new devices and methods to meet problems that did not exist at all a few years ago.

What is past is prologue . . .

Today and the future prevail.

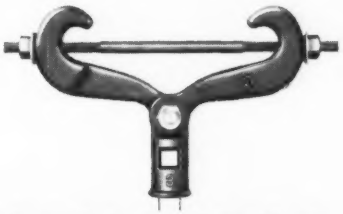
Diamond

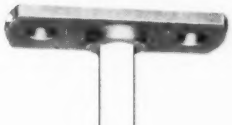
DIAMOND POWER SPECIALTY CORPORATION

LANCASTER, OHIO

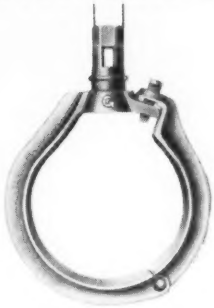
Diamond Specialty Limited, Windsor, Ontario

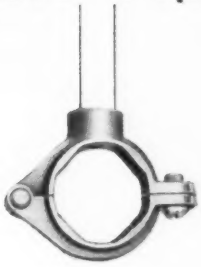
RUGGED STRENGTH... LESS WEIGHT





Grinnell *MALLEABLE IRON* Pipe Hangers





The fluidity of molten white iron allows casting of malleable pipe hangers in any desired form. Such hangers, designed in a manner consistent with the best malleable practice, are cast so closely to dimensions that subsequent shaping is not required.

Controlled annealing in the most modern equipment is employed to produce hangers having uniform internal grain structure, superiority ductility, high strength and freedom from casting strains. Quality controls in our foundries — such as hourly checks of metal, daily photomicrographs of metallurgical structure, tensile tests of sample bars from each melt — insure the rugged, lightweight strength of Grinnell malleable iron pipe hangers.

This start-to-finish manufacture by Grinnell assures malleable iron pipe hangers with a minimum safety factor of 5 or more, based on the ultimate tensile strength of the material.

The A.S.A. Code permits the use of malleable iron pipe clamps, embracing the pipe, when the temperature of the pipe does not exceed 450°F. When it does exceed this temperature, malleable iron may still be used in beam clamps, hanger flanges and the like if the malleable part is 12 inches or more distant from the pipe.

Testing metal structure with photomicrograph

Every Grinnell Malleable Iron Pipe Hanger offers . . .

- Safety Factor of at least 5
- Thickness of metal increased at points of concentrated stress
- Homogeneous metal composition throughout
- Extremely high resistance to impact and corrosion
- Economy
- Heat resistance up to 450°F

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

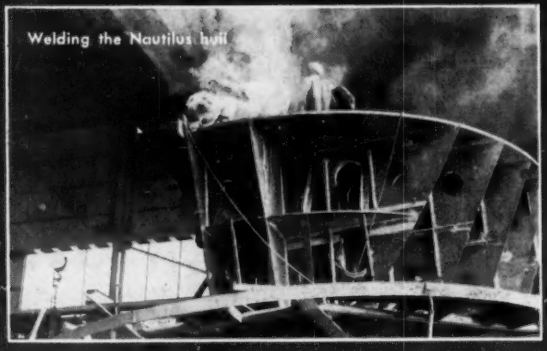
Grinnell Company, Inc., Providence, Rhode Island — Coast-to-Coast Network of Branch Warehouses and Distributors

Manufacturer of: pipe fittings • welding fittings • forged steel flanges • steel nipples • engineered pipe hangers and supports
Thermolier unit heaters • Grinnell-Saunders diaphragm valves • prefabricated piping • Grinnell automatic fire protection systems

Round-the-clock refineries depend on power services

keep your eye on

Hydraulic pumps power Eiffel Tower elevators



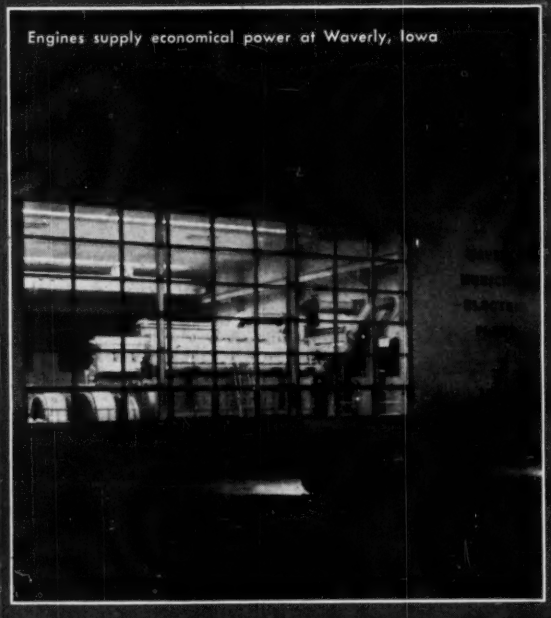
Welding the Nautilus hull

WORTHINGTON

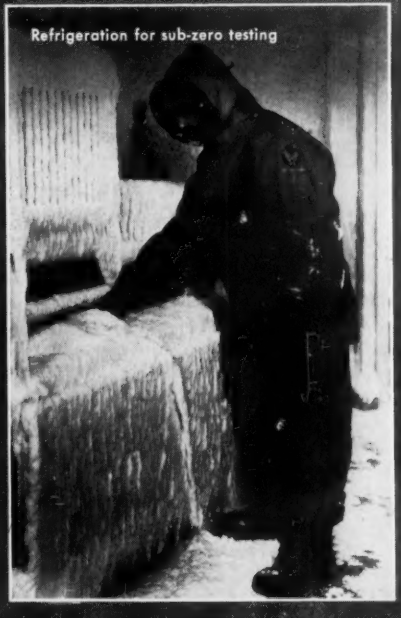
Mechanical power • Electrical power • Fluid power

Power to heat • Power to cool

***General Offices*: Harrison, New Jersey**



Engines supply economical power at Waverly, Iowa



Refrigeration for sub-zero testing

PRODUCTS

HEATING, AIR CONDITIONING AND REFRIGERATION
PUMPS
COMPRESSORS
ENGINES
STEAM CONDENSERS, FEEDWATER HEATERS AND STEAM-JET EJECTORS
STEAM TURBINES
ELECTRIC MOTORS, GENERATORS AND CONTROLS
CONSTRUCTION EQUIPMENT
AUTOMATIC CONTROL EQUIPMENT
LIQUID METERS
MECHANICAL POWER TRANSMISSION
POSITIONING EQUIPMENT
ELECTRIC BUS DUCT
INDUSTRIAL MIXERS